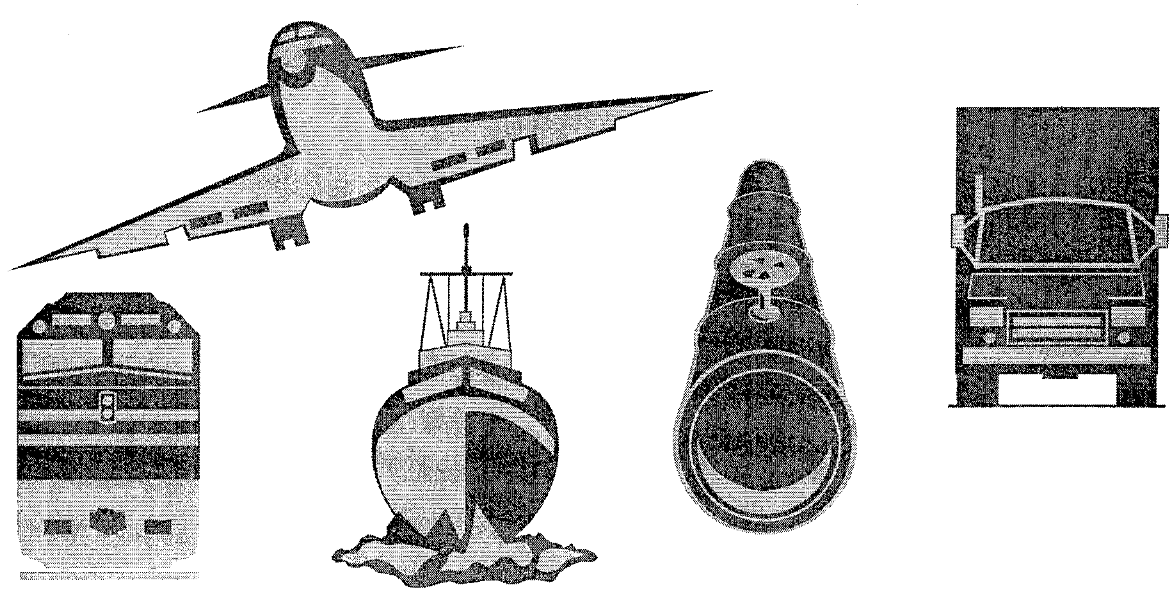
PB2002-916609
NTSB/REC-09/02

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

SAFETY RECOMMENDATIONS

ADOPTED SEPTEMBER 2002



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 13, 2002

In reply to refer to: H-02-15 through -18

Honorable Joseph M. Clapp
Administrator
Federal Motor Carrier Safety Administration
400 Seventh Street, SW
Washington, DC 20590

On May 31, 2001, about 3:28 p.m. central daylight time, a southbound Gayle Stuart Trucking, Inc., (Stuart Trucking) truck-tractor semitrailer exited Interstate 540 at State Highway 282 (SH-282) near Mountainburg, Arkansas. The driver was unable to stop at the stop sign at the bottom of the ramp. The 79,040-pound combination unit was traveling approximately 48 mph when it entered the intersection and collided with the right side of a westbound, 65-passenger, 1990 Blue Bird Corporation school bus operated by the Mountainburg, Arkansas, Public Schools. The school bus rotated approximately 300 degrees clockwise and overturned; the body, which partially separated from the chassis, came to rest on its right side on the eastbound shoulder of SH-282. The tractor semitrailer continued across the roadway, rotated about 60 degrees clockwise, overturned, and came to rest on its left side. Three school bus passengers seated across from the impact area were fatally injured; one was partially ejected. Two other passengers, one of whom was seated in the impact area, received serious injuries, and four passengers had minor injuries. The school bus driver and the truckdriver both sustained minor injuries.[1]

The National Transportation Safety Board determined that the probable cause of the accident was the truckdriver's inability to stop the tractor semitrailer at the stop sign at the bottom of the ramp due to the reduced braking efficiency of the truck's brakes, which had been poorly maintained and inadequately inspected. Contributing to the school bus passengers' injuries during the side impact were incomplete compartmentalization and the lack of energy-absorbing material on interior surfaces.

The tractor semitrailer in the Mountainburg accident was equipped with manual slack adjusters on the tractor brakes and automatic slack adjusters on the trailer. Eight of the 10 brakes were either out of adjustment or nonfunctional at the time of the accident, and 4 brakes were unable to provide any braking force, even without taking into account heat buildup and drum expansion.

[1] For additional information, read National Transportation Safety Board, *Collision Between Truck-Tractor Semitrailer and School Bus Near Mountainburg, Arkansas, on May 31, 2001*, Highway Accident Report NTSB/HAR-02/03 (Washington, DC: NTSB, 2002).

When some brakes are out of adjustment, the remaining brakes must provide greater braking force whenever they are applied in order to stop the vehicle, increasing the rate at which they wear and thus become out of adjustment. The brakes on the first axle (1R and 1L) provided limited braking force because they were improperly adjusted (1R provided no braking force for a period of time before the day of the accident, as evidenced by the rusted brake drum reported by the driver). Brakes on axles 3L, 4R, and 5L could not provide much, if any, braking force since they were nonfunctional owing to poor maintenance and other broken components. Therefore, the remaining 5 brakes (3 on the tractor and 2 on the trailer) had to provide the braking force for 10 brakes, 3 of which were out of adjustment.

The driver said that he did a visual inspection of the brakes on the day of the accident and did not find them to be out of adjustment. The *Commercial Driver's License Manual* recommends that during a pretrip inspection, the driver, at a minimum, pull on the pushrod and measure the stroke. If the stroke exceeds 1/2 to 1 inch, the brakes should be adjusted. Postaccident inspection showed that the stroke on five of the six tractor brakes exceeded 2 inches and that one other (3L), on which the stroke was restricted to 1 7/8 inch by a broken spring, also needed adjustment. Accident damage would not have affected the brakes' stroke.

The driver did not follow recommended practice for measuring stroke during the pretrip inspection, and a visual inspection did not allow him to determine that the brakes were out of adjustment. While the commercial driver's license (CDL) practice is only recommended, not mandatory, it is an important part of the pretrip inspection because of the safety-related nature of the brake system and the possible consequences, as in the case of this accident, when brakes are not adjusted properly. The Safety Board concludes that the driver did not conduct a sufficiently thorough pretrip inspection on either the tractor or the trailer to discover the brake deficiencies.

As 49 *Code of Federal Regulations* (CFR) 383.111(e)(4) and (g)(5) state, all commercial vehicle operators must have knowledge of procedures for conducting safe and accurate pretrip inspections and knowledge of airbrakes. Title 49 CFR 383.113 requires that all CDL applicants demonstrate pretrip inspection skills pertaining to airbrakes, including the ability to determine brake conditions and proper adjustment. Interviews with the accident driver indicated that he knew how to adjust brakes. While the accident driver did have a CDL, he did not demonstrate that he was knowledgeable about procedures for conducting a safe and accurate pretrip inspection on the day of the accident or about the consequences of not conducting a thorough pretrip inspection. However, 49 CFR 396.13(a) only stipulates that a driver be satisfied that the motor vehicle is in safe operating condition before driving it; the regulations specify neither what must be done during a pretrip inspection, nor which procedures must be performed daily on a vehicle.

The Safety Board has investigated other accidents in which pretrip inspection procedures were lax as well. On March 2, 1999, near Santa Fe, New Mexico, a motorcoach began descending a 14-mile mountainous roadway, and halfway down, the driver found that the brakes were providing no retarding force.[2] The driver lost control of the bus, and it departed the right side of the roadway, crashed into a rock embankment, and overturned. Investigators found that

[2] National Transportation Safety Board, *Motorcoach Loss of Control and Overturn, New Mexico State Route 475, March 2, 1999,* Highway Accident Brief NTSB/HAB-01/01 (Washington, DC: NTSB, 2001).

four of the bus's six brakes were out of adjustment at the time of the accident and two brakes were nonoperational. Company mechanics did not routinely examine driver pretrip inspection forms and did not know whether company drivers completed pretrip inspections. The busdriver reported that in the 10 months he had worked for the company, he had never completed a pretrip vehicle inspection. A review of company maintenance records revealed that some drivers were occasionally completing vehicle inspection reports.

Had the Mountainburg and Santa Fe drivers been required to measure the stroke on each brake and to determine its adjustment before they began driving on the day of the accident and had they fulfilled such a requirement, they may have discovered that some brakes were out of adjustment and taken appropriate corrective action. The Safety Board believes that the Federal Motor Carrier Safety Administration (FMCSA) should revise CFR 396.13, Driver Inspection, to require minimum pretrip inspection procedures for determining brake adjustment.

Stuart Trucking's most recent safety review prior to the Mountainburg accident took place on December 5, 1989, and resulted in a satisfactory rating. Following the accident, the FMCSA conducted a compliance review that resulted in a conditional rating for factor 2 (driver factor), an unsatisfactory rating for factor 5 (accident factor), and a conditional rating overall. FMCSA staff did not inspect any vehicles during this review, even though the accident was vehicle-related. They relied instead on the motor carrier profile report, which listed 29 roadside inspections in the previous 12 months, resulting in four out-of-service vehicles (14 percent), all with out-of-adjustment brakes. The regulations at 49 CFR Part 385, Appendix B, state that if fewer than 34 percent of vehicles (the national average) inspected in the previous 12 months (when more than three vehicles receive roadside inspections) are placed out of service, then the carrier is rated satisfactory for the vehicle factor, as was the case in the postaccident compliance review of Stuart Trucking.

Safety Board investigators were concerned that the FMCSA did not inspect any of Stuart Trucking's vehicles. This accident involved a vehicle in which 8 of 10 brakes were out of adjustment or nonfunctional and the carrier's mechanic was not a qualified brake inspector, suggesting that more vehicles may have had brake problems than were detected in the 12 months of roadside inspections, yet the FMCSA did not inspect any vehicles during the compliance review immediately following this accident. Consequently, the Safety Board asked the Missouri Division of Motor Vehicles and Railroad Safety to conduct an additional review of the carrier and inspect all its vehicles. Of 12 vehicles examined, 5 vehicles (42 percent) had out-of-service violations. Not only did this review reveal an out-of-service rate higher than the FMCSA recorded in its compliance review, but investigators also determined that the brakes had not been maintained properly. Improper maintenance, which cannot be detected without conducting vehicle inspections, can be telling as to the condition of a carrier's vehicles. The Safety Board concludes that based on the inspection conducted by the Missouri Division of Motor Vehicles and Railroad Safety that followed the accident, had FMCSA staff inspected Stuart Trucking's vehicles during the 2001 compliance review, the carrier would probably have received a conditional rating in factor 4 (vehicle factor) instead of a satisfactory rating.

The FMCSA's overreliance on roadside inspections when conducting compliance reviews may lead to underestimating the number of out-of-service vehicles. As noted above, the percentage of out-of-service vehicles found during the terminal inspection of Stuart Trucking was triple that found during the previous 12 months of roadside inspections. The Safety Board is concerned that carriers may be operating unsafe vehicles that are not detected during a roadside inspection or compliance review and that, as a result, the carrier's rating may be inaccurate because it misrepresents the proportion of out-of-service vehicles. The FMCSA will not conduct a terminal inspection if three or more of a company's vehicles received roadside inspections in the previous 12 months. But the vehicles that receive roadside inspections may not be representative of the entire fleet. The Safety Board believes that the FMCSA should require that vehicle inspections of a motor carrier's fleet be conducted during compliance reviews.

Title 49 CFR Part 396.24, Qualification of Brake Inspectors, requires that each brake inspector successfully complete an apprenticeship program or a training program or have a certificate or experience totaling 1 year; in addition, the motor carrier must maintain evidence of qualifications. Stuart Trucking's mechanic, who was responsible for maintaining most of the company's tractors and trailers, had not received any formal training in brake inspection, although he did have more than 1 year of experience and, under current rules, was eligible for certification. The owner said that he was not aware of the regulations requiring anyone who inspects or maintains brakes to be certified.

Although the person responsible for maintaining the brakes on the trailer of the accident vehicle had experience in brake maintenance, the condition of the trailer's brakes belied this experience, since three of the trailer's four brakes had broken parts or were nonfunctional at the time of the accident. Two brakes (4L and 5L) had broken springs, and during installation of one spring brake (4R), the pushrod was cut too short, rendering the automatic slack adjuster inoperable. Stuart Trucking's mechanic did not detect the latter problem in the 4 years between installation of the 4R spring brake in 1997 and the accident. In fact, brakes 4R and 5L had quite likely been inoperative for some time, since the brake drums were rusted, indicating the shoes had not been in contact with the drums. A qualified mechanic should have noticed this problem during routine maintenance and inspections.

In addition, the absence of grease at the fittings and brake camshaft bushings suggested a lack of periodic lubrication, and the Arkansas Highway Police and ArvinMeritor, Inc,[3] staff both commented on the poor overall condition of the trailer's brake system. During their follow-up vehicle inspection, Missouri Division of Motor Vehicle and Railroad Safety inspectors stated that Stuart Trucking staff's knowledge of truck maintenance seemed to be lacking; these inspectors also noted that some defects they found were obvious and did not appear to be recent. A brake inspector with sufficient training and knowledge would probably have identified the problems with the brakes on this semitrailer and fixed the brakes so that they were operative. The Safety Board concludes that the Stuart Trucking mechanic lacked proper training in brake maintenance and inspections, did not detect the poorly adjusted or inoperative brakes on the trailer, and did not perform recommended maintenance.

The Safety Board has investigated other accidents in which a motor carrier did not use a certified brake inspector to perform maintenance on its vehicles. In the aforementioned accident near Santa Fe in 1999, investigators found that the steering and drive axle brakes were out of adjustment, that the auxiliary weight-bearing axle brakes were not operational because they were

[3] ArvinMeritor is a supplier of commercial vehicle components, including air brakes.

"cammed over,"[4] and that both drums were worn beyond the manufacturer's acceptable limits. During postaccident inspection of the carrier by the New Mexico Motor Transport Division, all but two of the inspected motorcoaches were placed out of service due to mechanical defects, most of which were related to the brake systems. The carrier did not keep brake mechanic qualification records, as required, and none of the three company mechanics interviewed could adequately describe the maximum brake adjustment levels for the brakes on the motorcoaches, how to conduct a vehicle brake inspection, or how to adjust brakes.

Under the current compliance review process, the FMCSA does not consider violation of 40 CFR 396.25 "critical." Thus, if a motor carrier does not have a qualified brake inspector, it does not affect the carrier's rating. In fact, in its compliance review of Stuart Trucking, the FMCSA did not even note that a qualified brake inspector certificate was not on file. The Safety Board believes that during compliance reviews, the FMCSA should rate companies as unsatisfactory in the vehicle factor category if the mechanics and drivers responsible for maintaining brake systems are not qualified brake inspectors.

As the Mountainburg and Santa Fe accidents demonstrate, experience working in a maintenance shop is not always sufficient to ensure that a mechanic has the knowledge necessary to maintain a truck brake system. The FMCSA is remiss in permitting mechanics to work on brakes without knowing whether they have the requisite skills in brake maintenance. The Safety Board believes that the FMCSA should revise 49 CFR 396.25, Qualifications of Brake Inspectors, to require certification after testing as a prerequisite for qualification and specify, at a minimum, formal training in brake maintenance and inspection.

The National Transportation Safety Board recommends that the Federal Motor Carrier Safety Administration:

> Revise 49 *Code of Federal Regulations* 396.13, Driver Inspection, to require minimum pretrip inspection procedures for determining brake adjustment. (H-02-15)
>
> Require that vehicle inspections of a motor carrier's fleet be conducted during compliance reviews. (H-02-16)
>
> During compliance reviews, rate companies as unsatisfactory in the vehicle factor category if the mechanics and drivers responsible for maintaining brake systems are not qualified brake inspectors. (H-02-17)
>
> Revise 49 *Code of Federal Regulations* 396.25, Qualifications of Brake Inspectors, to require certification after testing as a prerequisite for qualification and specify, at a minimum, formal training in brake maintenance and inspection. (H-02-18)

---

[4] A condition in which the s-cam rotates beyond the service brake cam rollers and remains lodged in this position. The cause is generally a combination of out-of-adjustment brakes, worn brake shoes, and an excessively worn drum.

The Safety Board also issued safety recommendations to the National Highway Traffic Safety Administration, Commercial Vehicle Safety Alliance, National Fire Protection Association, and spring brake manufacturers and reiterated a recommendation to the U.S. Department of Transportation.

Please refer to Safety Recommendations H-02-15 through -18 in your reply. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

Original Signed

By: Marion C. Blakey
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 13, 2002

In reply refer to: H-02-19

Honorable Jeffrey W. Runge
Administrator
National Highway Traffic Safety Administration
400 Seventh Street, SW
Washington, DC 20590

On May 31, 2001, about 3:28 p.m. central daylight time, a southbound Gayle Stuart Trucking, Inc., truck-tractor semitrailer exited Interstate 540 at State Highway 282 (SH-282) near Mountainburg, Arkansas. The driver was unable to stop at the stop sign at the bottom of the ramp. The 79,040-pound combination unit was traveling approximately 48 mph when it entered the intersection and collided with the right side of a westbound, 65-passenger, 1990 Blue Bird Corporation school bus operated by the Mountainburg, Arkansas, Public Schools. The school bus rotated approximately 300 degrees clockwise and overturned; the body, which partially separated from the chassis, came to rest on its right side on the eastbound shoulder of SH-282. The tractor semitrailer continued across the roadway, rotated about 60 degrees clockwise, overturned, and came to rest on its left side. Three school bus passengers seated across from the impact area were fatally injured; one was partially ejected. Two other passengers, one of whom was seated in the impact area, received serious injuries, and four passengers had minor injuries. The school bus driver and the truckdriver both sustained minor injuries.[1]

The National Transportation Safety Board determined that the probable cause of the accident was the truckdriver's inability to stop the tractor semitrailer at the stop sign at the bottom of the ramp due to the reduced braking efficiency of the truck's brakes, which had been poorly maintained and inadequately inspected. Contributing to the school bus passengers' injuries during the side impact were incomplete compartmentalization and the lack of energy-absorbing material on interior surfaces.

The school bus in the Mountainburg accident was equipped with a propane fuel system that was in use at the time of the collision. The tractor semitrailer struck the bus just inches aft of the propane tank. While it has not made specific recommendations addressing retrofitted propane tanks on school buses, the Safety Board has previously recommended protecting fuel tanks on school buses to minimize the risk of fire. On February 29, 1972, a 1961 sedan ran a stop sign

[1] For additional information, read National Transportation Safety Board, *Collision Between Truck-Tractor Semitrailer and School Bus Near Mountainburg, Arkansas, on May 31, 2001*, Highway Accident Report NTSB/HAR-02/03 (Washington, DC: NTSB, 2002).

near Reston, Virginia,[2] and collided with a school bus carrying four children. The impact ruptured the school bus fuel tank, knocked it from the bus, and disabled the school bus service door. A fire ensued in the sedan due to gasoline spilled from the ruptured and detached school bus fuel tank, which was in a vulnerable location and lacked crash protection design features. The Safety Board urged that National Highway Traffic Safety Administration (NHTSA) and the Vehicle Equipment Safety Commission:

> <u>H-72-2</u>
>
> In consideration of the unnecessary hazards posed by locating school bus fuel tanks adjacent to service doors, act promptly to determine the "best" and "safest" location for school bus fuel tanks and to specify such location, as well as any protective shield or structural changes, to minimize the likelihood that a collision which might disable the service door or the emergency exit will also initiate a school bus fuel tank fire, and vice versa.

NHTSA replied that the rigorous side- and rear-impact barrier collision test requirements of Federal Motor Vehicle Safety Standard (FMVSS) 301 afforded a high level of protection for fuel systems on all vehicles up to 10,000 pounds gross vehicle weight rating. In addition, on September 19, 1974, the agency stated that a program to develop fuel system integrity tests for large school buses was planned. Such tests were later incorporated into FMVSS 301, and the Safety Board classified the recommendation "Closed—Acceptable Action" on September 6, 1985.

On May 14, 1988, a pickup truck traveling north in the southbound lanes of Interstate 71 struck a southbound church activity bus head-on near Carrollton, Kentucky.[3] The church bus fuel tank was punctured during the collision sequence and a fire ensued, engulfing the bus. The busdriver and 26 bus passengers were fatally injured, 34 passengers received minor to serious injuries, and 6 passengers were not injured. As a result of its investigation of this accident, the Safety Board asked that NHTSA:

> <u>H-89-6</u>
>
> Revise Federal Motor Vehicle Safety Standard 301 to provide additional protection for school buses in severe crash situations based on an evaluation of the merits of relocating fuel tanks, providing additional structure to protect fuel system components, and frangible valves in critical locations.

NHTSA replied on August 16, 1989, enclosing copies of an advance notice of proposed rulemaking to make the crash standards more stringent. In an April 11, 1991, letter, NHTSA stated that responses to the advance notice of proposed rulemaking did not provide clear direction for proposing changes to FMVSS 301. Thus, for the next step, NHTSA said it was

---

[2] National Transportation Safety Board, *School Bus/Automobile Collision and Fire Near Reston, Virginia, on February 29, 1972*, Highway Accident Report NTSB/HAR-72/02 (Washington, DC: NTSB, 1972).

[3] National Transportation Safety Board, *Pickup Truck/Church Activity Bus Head-on Collision and Fire Near Carrollton, Kentucky, on May 14, 1988*, Highway Accident Report NTSB/HAR-89/01 (Washington, DC: NTSB, 1989).

considering several options, including a research program to develop the technical information necessary to evaluate ways to improve the fuel system integrity of buses. On October 20, 1995, NHTSA reported that those commenting on the advance notice of proposed rulemaking agreed that FMVSS 301 was adequate and that manufacturers generally comply with the requirements by adding a cage around the fuel tank. The Safety Board classified the recommendation "Closed—Acceptable Action" on May 15, 1996, citing its understanding that school bus manufacturers generally comply with stringent regulatory crash test requirements for large school bus fuel systems by adding a cage around the fuel tank.

These safety recommendations, issued over the past 3 decades, encouraged NHTSA and the school bus manufacturers to make fuel tanks on school buses safer. However, none of NHTSA's fuel tank safety requirements for school buses apply to propane tanks.

The propane tank, which had been retrofitted on the accident school bus, was installed in accordance with National Fire Protection Association (NFPA) Standard 58, "Standard for the Storage and Handling of Liquefied Petroleum Gases." The Safety Board is concerned that this standard does not adequately protect propane fuel systems during a crash. Unlike gasoline and compressed natural gas systems, which are fitted onto school buses by the manufacturer, propane and other retrofitted fuel systems are not required to meet NHTSA crash test standards specified in FMVSSs 301 and 303. These standards require that gasoline and compressed natural gas systems mounted on a vehicle withstand a barrier crash test. Propane systems must pass no such test, and NHTSA cannot even regulate propane system testing because propane systems are aftermarket installations and therefore not subject to NHTSA safety standards. Most States (Idaho is the only exception) require that propane systems meet NFPA standards. While propane systems must have a discharge valve, this valve will not prevent a fire from occurring during a severe crash if the system is compromised.

To further protect gasoline and diesel fuel tanks on school buses from being compromised, school bus manufacturers place them within a cage, even though not required to do so. In fact, a rigid safety cage enclosed the manufacturer-installed fuel tank on the accident school bus. The propane tank did not have such protection. As discussed above, the Safety Board has investigated school bus crashes in which cages did not enclose fuel tanks, and severe fires and loss of life ensued. The Safety Board concludes that catastrophic fires involving vehicles equipped with propane tanks could happen because these tanks are not protected from collision and, thus, could rupture if struck.

Current legislation generally prohibits NHTSA from regulating aftermarket equipment installed on vehicles. However, in this case, the children riding on the school bus did not receive the same level of protection as those children riding on buses equipped with gasoline, diesel, or compressed natural gas tanks, which NHTSA does regulate.

Therefore, the National Transportation Safety Board recommends that the National Highway Traffic Safety Administration:

> Obtain the authority, as necessary, and include propane fuel system integrity standards for aftermarket installations in the *Federal Motor Vehicle Safety Standards*. (H-02-19)

The Safety Board also issued safety recommendations to the Federal Motor Carrier Safety Administration, Commercial Vehicle Safety Alliance, National Fire Protection Association, and spring brake manufacturers and reiterated a recommendation to the U.S. Department of Transportation.

Please refer to Safety Recommendation H-02-19 in your reply. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Marion C. Blakey
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 13, 2002

In reply refer to: H-02-20

Mr. Stephen Campbell
Executive Director
Commercial Vehicle Safety Alliance
5430 Grosvenor Lane, Suite 130
Bethesda, Maryland 20814

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

This recommendation addresses caging port dust cover inspections. The recommendation is derived from the Safety Board's investigation of the May 31, 2001, collision between a truck-tractor semitrailer and a school bus near Mountainburg, Arkansas,[1] and is consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued eight safety recommendations, one of which is addressed to the Commercial Vehicle Safety Alliance (CVSA). Information supporting this recommendation is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendation.

On May 31, 2001, about 3:28 p.m. central daylight time, a southbound Gayle Stuart Trucking, Inc., truck-tractor semitrailer exited Interstate 540 at State Highway 282 (SH-282) near Mountainburg. The driver was unable to stop at the stop sign at the bottom of the ramp. The 79,040-pound combination unit was traveling approximately 48 mph when it entered the intersection and collided with the right side of a westbound, 65-passenger, 1990 Blue Bird Corporation school bus operated by the Mountainburg, Arkansas, Public Schools. The school bus rotated approximately 300 degrees clockwise and overturned; the body, which partially separated from the chassis, came to rest on its right side on the eastbound shoulder of SH-282. The tractor semitrailer continued across the roadway, rotated about 60 degrees clockwise, overturned, and came to rest on its left side. Three school bus passengers seated across from the impact area were fatally injured; one was partially ejected. Two other passengers, one of whom was seated in the

[1] For additional information, read National Transportation Safety Board, *Collision Between Truck-Tractor Semitrailer and School Bus Near Mountainburg, Arkansas, on May 31, 2001,* Highway Accident Report NTSB/HAR-02/03 (Washington, DC: NTSB, 2002).

impact area, received serious injuries, and four passengers had minor injuries. The school bus driver and the truckdriver both sustained minor injuries.

The Safety Board determined that the probable cause of the accident was the truckdriver's inability to stop the tractor semitrailer at the stop sign at the bottom of the ramp due to the reduced braking efficiency of the truck's brakes, which had been poorly maintained and inadequately inspected. Contributing to the school bus passengers' injuries during the side impact were incomplete compartmentalization and the lack of energy-absorbing material on interior surfaces.

Of six brakes on the tractor semitrailer equipped with spring brakes for emergency-parking brake application (axles 3, 4, and 5), three had broken springs. The 3L brake spring was broken in three pieces, restricting total stroke by 3/8 inch. Thus, even though the 3L brake appeared to be within adjustment at 1 7/8 inches, it was not.

The 4L brake spring was broken in two pieces, and dynamic testing of the vehicle showed that the broken spring did not prevent service brake application; the service brakes even locked during one test. When the emergency-parking brake was applied during another test, the 4L brake provided some braking force (the service brake locked on gravel but not on concrete), indicating the emergency-parking brake force was reduced due to the broken spring, but was not completely eliminated.

The 5L brake spring was also broken and blocking the pushrod, thereby limiting pushrod stroke and preventing it from reaching the minimum 1 1/2 inches necessary for the automatic adjuster to begin readjustment. During testing, 5L did not provide any braking force when either the emergency-parking brake or the service brake was applied. In other words, both the emergency-parking brake and the service brake were nonfunctional.

Thus, a broken spring, in addition to reducing the braking ability of the emergency-parking brake or rendering it inoperable, can have a detrimental effect on the service brakes, as was the case in this accident. Broken springs on two of the vehicle's three brakes prevented proper brake adjustment, thereby contributing to a reduction of the tractor semitrailer's braking efficiency.

The caging that houses brake springs makes detection of broken springs difficult because access to the closed chamber is restricted. One method of detection involves inserting an optical device called a borescope into the caging port. Another entails inserting a finger inside the caging port, but doing so can be extremely dangerous during roadside inspections; if the truck moves, the spring breaks, or the driver applies or releases the parking brake, the inspector can be injured. If the spring brake is equipped with an integrated caging bolt, then it has no port for accessing the spring. Brake springs are neither a CVSA out-of-service item nor an inspection item. However, as this accident demonstrates, broken springs can have safety consequences when they prevent proper adjustment of the service brake or decrease the braking capability of the emergency-parking brake. The Safety Board concludes that because of the spring brake design, examining the springs to determine whether they were broken was difficult on three of the truck's brakes. The Safety Board made a recommendation to spring brake manufacturers to redesign spring brakes to allow inspectors or mechanics to view components to determine whether the spring is broken. Once this has been accomplished, the Safety Board looks forward to working with the CVSA to incorporate inspection of spring brake components into vehicle inspection criteria.

Springs break for various reasons, including exposure to the elements, number of brake applications, age, or material properties. Contaminants can enter spring brake chambers through the caging ports unless dust covers are in place to prevent contaminants from entering. These contaminants, such as salt and water, can weaken the material properties of the spring, making it more susceptible to breakage. On the accident vehicle, dust covers were missing on all four spring brakes that had caging ports. Evidence of a white substance, probably salt deposits, was present inside the 4L spring chamber, and salt can corrode a spring, leading to its failure. The Safety Board concludes that dust covers on the caging ports of the accident vehicle's spring brakes would have reduced the chance of corrosion to the spring, possibly prolonging the life of the spring and, in turn, the life of the emergency-service brakes.

Therefore, the National Transportation Safety Board recommends that the Commercial Vehicle Safety Alliance:

> Include spring brake caging port dust covers as an inspection item during Motor Carrier Safety Assistance Program roadside inspections. (H-02-20)

The Safety Board also issued safety recommendations to the Federal Motor Carrier Safety Administration, National Highway Traffic Safety Administration, National Fire Protection Association, and spring brake manufacturers and reiterated a recommendation to the U.S. Department of Transportation. In your response to the recommendation in this letter, please refer to H-02-20. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Marion C. Blakey
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 13, 2002

In reply refer to: H-02-21

Mr. James M. Shannon
President and Chief Executive Officer
National Fire Protection Association
1 Batterymarch Park
Quincy, Massachusetts 02269

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

This recommendation addresses the use of propane tanks on school buses. The recommendation is derived from the Safety Board's investigation of the May 31, 2001, collision between a truck-tractor semitrailer and a school bus near Mountainburg, Arkansas,[1] and is consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued eight safety recommendations, one of which is addressed to the National Fire Protection Association (NFPA). Information supporting this recommendation is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendation.

On May 31, 2001, about 3:28 p.m. central daylight time, a southbound Gayle Stuart Trucking, Inc., truck-tractor semitrailer exited Interstate 540 at State Highway 282 (SH-282) near Mountainburg. The driver was unable to stop at the stop sign at the bottom of the ramp. The 79,040-pound combination unit was traveling approximately 48 mph when it entered the intersection and collided with the right side of a westbound, 65-passenger, 1990 Blue Bird Corporation school bus operated by the Mountainburg, Arkansas, Public Schools. The school bus rotated approximately 300 degrees clockwise and overturned; the body, which partially separated from the chassis, came to rest on its right side on the eastbound shoulder of SH-282. The tractor semitrailer continued across the roadway, rotated about 60 degrees clockwise, overturned, and came to rest on its left side. Three school bus passengers seated across from the impact area were fatally injured; one was partially ejected. Two other passengers, one of whom was seated in the

[1] For additional information, read National Transportation Safety Board, *Collision Between Truck-Tractor Semitrailer and School Bus Near Mountainburg, Arkansas, on May 31, 2001*, Highway Accident Report NTSB/HAR-02/03 (Washington, DC: NTSB, 2002).

impact area, received serious injuries, and four passengers had minor injuries. The school bus driver and the truckdriver both sustained minor injuries.

The Safety Board determined that the probable cause of the accident was the truckdriver's inability to stop the tractor semitrailer at the stop sign at the bottom of the ramp due to the reduced braking efficiency of the truck's brakes, which had been poorly maintained and inadequately inspected. Contributing to the school bus passengers' injuries during the side impact were incomplete compartmentalization and the lack of energy-absorbing material on interior surfaces.

The school bus in the Mountainburg accident was equipped with a propane fuel system that was in use at the time of the collision. The tractor semitrailer struck the bus just inches aft of the propane tank. While it has not made specific recommendations addressing retrofitted propane tanks on school buses, the Safety Board has previously recommended protecting fuel tanks on school buses to minimize the risk of fire. On February 29, 1972, a 1961 sedan ran a stop sign near Reston, Virginia,[2] and collided with a school bus carrying four children. The impact ruptured the school bus fuel tank, knocked it from the bus, and disabled the school bus service door. A fire ensued in the sedan due to gasoline spilled from the ruptured and detached school bus fuel tank, which was in a vulnerable location and lacked crash protection design features. The Safety Board recommended that National Highway Traffic Safety Administration (NHTSA) and the Vehicle Equipment Safety Commission:

> <u>H-72-2</u>
>
> In consideration of the unnecessary hazards posed by locating school bus fuel tanks adjacent to service doors, act promptly to determine the "best" and "safest" location for school bus fuel tanks and to specify such location, as well as any protective shield or structural changes, to minimize the likelihood that a collision which might disable the service door or the emergency exit will also initiate a school bus fuel tank fire, and vice versa.

NHTSA replied that the rigorous side- and rear-impact barrier collision test requirements of Federal Motor Vehicle Safety Standard (FMVSS) 301 afforded a high level of protection for fuel systems on all vehicles up to 10,000 pounds gross vehicle weight rating. In addition, on September 19, 1974, the agency stated that a program to develop fuel system integrity tests for large school buses was planned. Such tests were later incorporated into FMVSS 301, and the Safety Board classified Safety Recommendation H-72-2 "Closed—Acceptable Action" on September 6, 1985.

On May 14, 1988, a pickup truck traveling north in the southbound lanes of Interstate 71 struck a southbound church activity bus head-on near Carrollton, Kentucky.[3] The church bus fuel tank was punctured during the collision sequence and a fire ensued, engulfing the bus. The

---

[2] National Transportation Safety Board, *School Bus/Automobile Collision and Fire Near Reston, Virginia, on February 29, 1972*, Highway Accident Report NTSB/HAR-72/02 (Washington, DC: NTSB, 1972).

[3] National Transportation Safety Board, *Pickup Truck/Church Activity Bus Head-on Collision and Fire Near Carrollton, Kentucky, on May 14, 1988*, Highway Accident Report NTSB/HAR-89/01 (Washington, DC: NTSB, 1989).

busdriver and 26 bus passengers were fatally injured, 34 passengers received minor to serious injuries, and 6 passengers were not injured. As a result of its investigation of this accident, the Safety Board recommended that NHTSA:

> H-89-6
>
> Revise Federal Motor Vehicle Safety Standard 301 to provide additional protection for school buses in severe crash situations based on an evaluation of the merits of relocating fuel tanks, providing additional structure to protect fuel system components, and frangible valves in critical locations.

NHTSA replied on August 16, 1989, enclosing copies of an advance notice of proposed rulemaking to make the crash standards more stringent. In an April 11, 1991, letter, NHTSA stated that responses to the advance notice of proposed rulemaking did not provide clear direction for proposing changes to FMVSS 301. Thus, for the next step, NHTSA said it was considering several options, including a research program to develop the technical information necessary to evaluate ways to improve the fuel system integrity of buses. On October 20, 1995, NHTSA reported that those commenting on the advance notice of proposed rulemaking agreed that FMVSS 301 was adequate and that manufacturers generally comply with the requirements by adding a cage around the fuel tank. The Safety Board classified Safety Recommendation H-89-6 "Closed—Acceptable Action" on May 15, 1996, citing its understanding that school bus manufacturers generally comply with stringent regulatory crash test requirements for large school bus fuel systems by adding a cage around the fuel tank.

These safety recommendations, issued over the past 3 decades, encouraged NHTSA and the school bus manufacturers to make fuel tanks on school buses safer. However, none of NHTSA's fuel tank safety requirements for school buses apply to propane tanks.

The propane tank, which had been retrofitted on the accident school bus, was installed in accordance with NFPA Standard 58, 'Standard for the Storage and Handling of Liquefied Petroleum Gases." The Safety Board is concerned that this standard does not adequately protect propane systems during a crash. Unlike gasoline and compressed natural gas systems, which are fitted onto school buses by the manufacturer, propane and other retrofitted fuel systems are not required to meet NHTSA crash test standards specified in FMVSSs 301 and 303. These standards require that gasoline and compressed natural gas systems mounted on a vehicle withstand a barrier crash test. Propane systems must pass no such test, and NHTSA cannot even regulate propane tank testing because propane tanks are aftermarket installations and therefore not subject to NHTSA safety standards. Most States (Idaho is the only exception) require that propane systems meet NFPA standards. While propane systems must have a discharge valve, this valve will not prevent a fire from occurring during a severe crash if the fuel system is compromised.

To further protect gasoline and diesel fuel tanks on school buses from being compromised, school bus manufacturers place them within a cage, even though not required to do so. In fact, a rigid safety cage enclosed the manufacturer-installed fuel tank on the accident school bus. The propane tank did not have such protection. As discussed above, the Safety Board has investigated school bus crashes in which cages did not enclose fuel tanks, and severe fires and loss of life ensued. The Safety Board concludes that catastrophic fires involving vehicles equipped with propane tanks could happen because these tanks are not protected from collision and, thus, could rupture if struck.

Therefore, the National Transportation Safety Board recommends that the National Fire Protection Association:

> Amend National Fire Protection Association Standard 58, Storage and Handling of Liquefied Petroleum Gas, to require that (1) propane fuel systems installed in school buses be protected and (2) propane fuel systems meet the equivalent to Federal Motor Vehicle Safety Standard 301 crash protection standards. (H-02-21)

The Safety Board also issued safety recommendations to the Federal Motor Carrier Safety Administration, National Highway Traffic Safety Administration, Commercial Vehicle Safety Alliance, and spring brake manufacturers and reiterated a recommendation to the U.S. Department of Transportation. In your response to the recommendation in this letter, please refer to H-02-21. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Marion C. Blakey
Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 13, 2002

In reply refer to: H-02-22

Spring Brake Manufacturers
(See Attached List)

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

This recommendation addresses spring brake design to facilitate inspection. The recommendation is derived from the Safety Board's investigation of the May 31, 2001, collision between a truck-tractor semitrailer and a school bus near Mountainburg, Arkansas,[1] and is consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued eight safety recommendations, one of which is addressed to spring brake manufacturers. Information supporting this recommendation is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendation.

On May 31, 2001, about 3:28 p.m. central daylight time, a southbound Gayle Stuart Trucking, Inc., truck-tractor semitrailer exited Interstate 540 at State Highway 282 (SH-282) near Mountainburg. The driver was unable to stop at the stop sign at the bottom of the ramp. The 79,040-pound combination unit was traveling approximately 48 mph when it entered the intersection and collided with the right side of a westbound, 65-passenger, 1990 Blue Bird Corporation school bus operated by the Mountainburg, Arkansas, Public Schools. The school bus rotated approximately 300 degrees clockwise and overturned; the body, which partially separated from the chassis, came to rest on its right side on the eastbound shoulder of SH-282. The tractor semitrailer continued across the roadway, rotated about 60 degrees clockwise, overturned, and came to rest on its left side. Three school bus passengers seated across from the impact area were fatally injured; one was partially ejected. Two other passengers, one of whom was seated in the impact area, received serious injuries, and four passengers had minor injuries. The school bus driver and the truckdriver both sustained minor injuries.

[1] For additional information, read National Transportation Safety Board, *Collision Between Truck-Tractor Semitrailer and School Bus Near Mountainburg, Arkansas, on May 31, 2001*, Highway Accident Report NTSB/HAR-02/03 (Washington, DC: NTSB, 2002).

The Safety Board determined that the probable cause of the accident was the truckdriver's inability to stop the tractor semitrailer at the stop sign at the bottom of the ramp due to the reduced braking efficiency of the truck's brakes, which had been poorly maintained and inadequately inspected. Contributing to the school bus passengers' injuries during the side impact were incomplete compartmentalization and the lack of energy-absorbing material on interior surfaces.

Of six brakes on the tractor semitrailer equipped with spring brakes for emergency-parking brake application (axles 3, 4, and 5), three had broken springs. The 3L brake spring was broken in three pieces, restricting total stroke by 3/8 inch. Thus, even though the 3L brake appeared to be within adjustment at 1 7/8 inches, it was not.

The 4L brake spring was broken in two pieces, and dynamic testing of the vehicle showed that the broken spring did not prevent service brake application; the service brakes even locked during one test. When the emergency-parking brake was applied during another test, the 4L brake provided some braking force (the service brake locked on gravel but not on concrete), indicating the emergency-parking brake force was reduced due to the broken spring, but was not completely eliminated.

The 5L brake spring was also broken and blocking the pushrod, thereby limiting pushrod stroke and preventing it from reaching the minimum 1 1/2 inches necessary for the automatic adjuster to begin readjustment. During testing, the 5L brake did not provide any braking force when either the emergency-parking brake or the service brake was applied. In other words, both the emergency-parking brake and the service brake were nonfunctional.

Thus, a broken spring, in addition to reducing the braking ability of the emergency-parking brake or rendering it inoperable, can have a detrimental effect on the service brakes, as was the case in this accident. Broken springs on two of the vehicle's three brakes prevented proper brake adjustment, thereby contributing to a reduction of the tractor semitrailer's braking efficiency.

The design of brake springs makes detection of broken springs difficult because access to the closed chamber is restricted. One method of detection involves inserting an optical device called a borescope into the caging port. Another entails inserting a finger inside the caging port, but doing so can be extremely dangerous during roadside inspections; if the truck moves, the spring breaks, or the driver applies or releases the parking brake, the inspector can be injured. If the spring brake is equipped with an integrated caging bolt, then it has no port for accessing the spring. Brake springs are neither a Commercial Vehicle Safety Alliance out-of-service item nor an inspection item. However, as this accident demonstrates, broken springs can have safety consequences when they prevent proper adjustment of the service brake or decrease the braking capability of the emergency-parking brake. The Safety Board concludes that because of the spring brake design, examining the springs to determine whether they were broken was difficult on three of the truck's brakes.

Therefore, the National Transportation Safety Board recommends that spring brake manufacturers:

Develop a spring brake that allows inspectors or mechanics to view components safely to determine whether the spring is broken. (H-02-22)

The Safety Board also issued safety recommendations to the Federal Motor Carrier Safety Administration, National Highway Traffic Safety Administration, Commercial Vehicle Safety Alliance, and National Fire Protection Association and reiterated a recommendation to the U.S. Department of Transportation. In your response to the recommendation in this letter, please refer to H-02-22. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Marion C. Blakey
Chairman

Mr. Joe McAleese
President
Bendix Commercial Vehicle Systems, LLC
901 Cleveland Street
Elyria, Ohio 44035

Mr. Tom Hogan
President
Carlisle Motion Control Industries, Inc.
4040 Lewis and Clark Drive
Charlottesville, Virginia 22911

Mr. Robert P. Joy
President
Haldex Brake Systems North America
10930 North Pomona Avenue
Kansas City, Missouri 64153

Mr. Ron Parker
Chairman, President, and Chief Executive Officer
Indian Head Industries, Inc.
MGM Brakes
8530 Cliff Cameron Drive
Charlotte, North Carolina 28269

Mr. Ted Smith
President
TSE Brakes, Inc.
3183 South Parkway Drive
Fresno, California 93725-2317

National Transportation Safety Board
Washington, D.C. 20594

Safety Recommendation

Date: September 17, 2002

In reply refer to: A-02-26 through -32

Honorable Marion C. Blakey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On November 20, 2000, about 1222 eastern standard time,[1] a flight attendant/purser was killed during an emergency evacuation of American Airlines flight 1291, an Airbus Industrie A300B4-605R (A300), N14056, at Miami International Airport (MIA), Miami, Florida. The airplane was pressurized until the flight attendant/purser opened the left front (1L) emergency exit door; he was then forcibly ejected from the airplane. There were 133 persons on board. During the emergency evacuation, in addition to the 1 flight attendant/purser who was killed, 3 passengers sustained serious injuries; 18 passengers and 1 flight service director[2] sustained minor injuries; and the 2 pilots, 6 flight attendants, 1 off-duty flight attendant, 1 flight service director, and the remaining 100 passengers reported no injuries. The airplane sustained minor damage.[3]

The flight was operating as a 14 *Code of Federal Regulations* Part 121 scheduled international passenger flight. Visual meteorological conditions prevailed, and an instrument flight plan was filed. The flight departed MIA for Port Au Prince International Airport, Haiti, and had been airborne for about 8 minutes when the flight crew encountered a problem with the automatic pressurization system. The captain later stated to National Transportation Safety Board investigators that the automatic cabin pressurization controllers would not control cabin pressure when the airplane was climbing through 16,000 feet and that the electronic centralized airplane monitor (ECAM) display[4] indicated that the forward outflow valve[5] was fully open.[6] The captain

[1] All times in this letter are eastern standard time, based on a 24-hour clock.

[2] Flight service directors are language translators who are assigned to selected flights to assist flight attendants in communicating with passengers. Although flight service director training requires that they observe flight attendant emergency procedures training, they are not qualified as flight attendants.

[3] The description for this accident, MIA01FA029, can be found on the National Transportation Safety Board's Web site at <http://www.ntsb.gov>.

[4] The ECAM display is a cathode ray tube screen located in the cockpit. The system is automatic and displays messages and system diagrams to pilots. It provides operational assistance for both normal and abnormal airplane system situations.

[5] The two outflow valves open and close during flight and on the ground to maintain control of cabin pressurization.

[6] At this point in flight, the valves would normally be over halfway closed. Postaccident examination of the airplane by the Safety Board's Systems Group revealed that insulation blankets partially blocked the forward outflow valve and almost fully blocked the aft outflow valve.

stated that when he called up the pressurization system ECAM display, the outflow valve positions were displayed in amber, indicating that an outflow valve was over 95 percent open. The cabin altitude was climbing at a rate of 2,000 feet per minute, and the cabin altitude indicator showed 7,000 feet. The captain decided to operate the pressurization system in the manual mode and, about 11 minutes after departure, indicated to air traffic control (ATC) that the flight would return to MIA. At that point, the pilots began performing the American Airlines A300[7] Cabin Pressurization Manual Control Checklist,[8] which is contained in the American Airlines A300 operating manual.

The captain stated to Safety Board investigators that during the return to MIA, the flight attendant call chimes sounded erratically, and the lavatory smoke detectors[9] sounded continually. The flight attendants also reported that the call chimes at the flight attendant telephone stations sounded intermittently and that the white CAPT CALL (captain call) lights illuminated. They stated that when they answered the phones (expecting that a flight crewmember was calling), they did not hear anything. One flight attendant stated that she tried to reset her phone, but it continued to ring. Passengers and cabin crewmembers complained about pressure in their ears. About 3 minutes before landing, the captain declared an emergency to ATC and requested that aircraft rescue and firefighting (ARFF) personnel stand by for the landing. After the airplane landed at MIA, ARFF personnel checked the exterior of the airplane and reported no signs of fire. The cockpit voice recorder (CVR) indicates that a flight attendant reported smelling smoke to the flight crew. The captain indicated to Board investigators that he observed the illumination of a "cargo loop light"[10] on the cockpit overhead panel. The captain then ordered an emergency evacuation of the airplane, and the American Airlines A300 Ground Evacuation Checklist[11] was performed.

The flight attendants heard the sounding of the evacuation signaling system and attempted to open the emergency exit doors to begin the emergency evacuation but were having difficulty doing so. A flight attendant reported to the flight crew that the doors would not open. While the flight attendant/purser was struggling to open the 1L emergency exit door of the airplane, the door suddenly burst open, and he was forcibly ejected onto the ramp and was killed. Preliminary findings from the investigation revealed that excess air pressure inside the cabin caused the door to burst open when the flight attendant/purser attempted to open it. This accident investigation is ongoing.[12]

---

[7] All A300 airplanes that American Airlines operates are A300-600 airplanes.

[8] The American Airlines A300 Cabin Pressurization Manual Control Checklist is similar to that of Airbus. The entire checklist cannot be performed at one time; rather, pilots must initiate the checklist and then complete it later in flight. According to the accident captain, he did not perform all of the items in the Cabin Pressurization Manual Control Checklist because of his other priorities at the time, including addressing the smoke indications and landing the airplane.

[9] No evidence of fire in any of the lavatories was found in the Safety Board's postaccident examination of the airplane.

[10] Illumination of a light on the CARGO COMPT SMOKE DET panel may indicate a fire in the cargo compartment. No evidence of fire was found in the Safety Board's postaccident examination of the airplane.

[11] The American Airlines A300 Ground Evacuation Checklist, which is contained in the American Airlines A300 operating manual, is similar to the Airbus A300-600 On Ground/Emergency Evacuation Checklist.

[12] The Safety Board notes that the flight crew failed to select the Cabin Vertical Speed Control switch to the UP position, which would have opened the outflow valves when the pressurization system was in the manual mode and would likely have depressurized the airplane. On May 8, 2001, the Board issued Safety Recommendations A-01-16

During the Safety Board's investigation of this accident, a similar accident occurred on October 20, 2001. In that accident, one flight attendant was killed and another flight attendant was seriously injured during the deplaning of TunisAir flight TARB631, an Airbus A300-605R, Tunisian registration TS-IPA, at Djerba Airport, Djerba, Tunisia. The flight was conducted as a scheduled international passenger flight from Geneva, Switzerland, to Djerba. There were 2 flight crewmembers, 10 cabin crewmembers, and 134 passengers on board.

According to Airbus, on the flight to Geneva before the October 20, 2001, accident flight, the flight crew received an excessive cabin altitude warning and then placed the pressurization system in manual mode. The airplane landed safely at Geneva, and maintenance personnel inspected the airplane and found no anomalies. The airplane was then dispatched on the accident flight from Geneva to Djerba.

According to Airbus, while the flight was enroute to Djerba, the flight crew again received an excessive cabin altitude warning and immediately placed the pressurization system in manual mode. The remainder of the flight and the landing at Djerba were uneventful. The airplane was parked at Djerba, and the engine bleed air was still turned on, allowing pressurized air into the airplane. While an air stair was being positioned to the 2L door of the airplane, a flight attendant attempted to open the 2L door. Excessive cabin pressure caused the door to burst open, and the flight attendant who opened the door was ejected and sustained serious injuries. A flight attendant who was standing near the flight attendant who opened the door was also ejected from the airplane and was killed.

The Safety Board has identified several safety issues relating to these accidents that require the FAA's attention.

Cabin Altitude Gauge

Airplane pressurization systems can be operated in automatic and manual modes. The manual mode of operation is used on the Airbus A300-600 airplane when the automatic mode becomes inoperative and allows the flight crew to manually operate the electric motors that control the outflow valves. The A300 pressurization system includes the following three gauges that indicate pressurization information to the flight crew when the airplane's pressurization

through -22 to the Federal Aviation Administration (FAA) regarding information contained in the Airbus Industrie A300-600 operating manual and checklists (Safety Recommendations A-01-16, -17, and -20) and A300-600 operators' operating manuals, checklists, and training programs (Safety Recommendations A-01-18, -19, -21, and -22). Safety issues included the adequacy of information regarding depressurization of the airplane when the pressurization system is being operated in the manual mode; the need for the flight crew to verify that the cabin differential pressure is 0 pounds per square inch (psi) before signaling the flight attendants to begin an emergency evacuation; and the need for the flight crew to verify that the cabin differential pressure is 0 psi before permitting the flight attendants or gate agents to open the cabin doors. In a January 23, 2002, letter to the FAA, the Board classified Safety Recommendations A-01-16, -17, and -20 "Open—Acceptable Response" and Safety Recommendations A-01-18, -19, -21, and -22 "Open—Unacceptable Response."

system is being operated in the manual mode:[13] the cabin altimeter,[14] the cabin vertical speed indicator, and the cabin differential pressure indicator.[15]

The cabin altimeter is located on the cockpit overhead panel and is marked with values from 20,000 to -5,000 feet. (Figure 1 shows a cabin altimeter from an Airbus A300 airplane.) Unmarked space separates the -5,000-foot mark and the 20,000-foot mark on the gauge. The needle on the gauge moves clockwise into the positive range to indicate higher cabin altitudes as the cabin pressure decreases and moves counterclockwise to indicate lower cabin altitudes as the cabin pressure increases. The investigation determined that when cabin pressure increases such that the cabin altitude is less than -5,000 feet, the cabin altimeter needle moves counterclockwise through the negative altitude range, including past the -5,000 mark, through the unmarked area, and into the highest end of the positive altitude range. There are no mechanical stops on the cabin altimeter that restrict the needle to the marked areas of the gauge and prevent the needle from traveling to the positive altitude range when the cabin altitude is actually beyond -5,000 in the negative range.

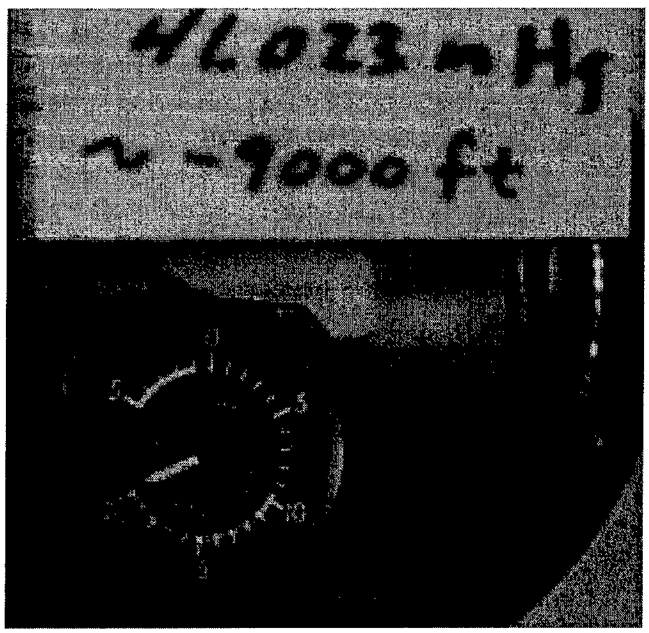


Figure 1. Cabin altimeter from an Airbus A300 airplane.

The investigation determined that at one point during American Airlines flight 1291's approach to MIA, the cabin altitude reached -12,100 feet. Specifically, at 1212:31, the CVR recorded a sound similar to a lavatory smoke detector. During postaccident testing of the

[13] When the airplane's pressurization system is being operated in the automatic mode, the Engine Indication and Crew Alerting System (EICAS) displays the same information that these three gauges display. However, when the pressurization system is being operated in the manual mode, the EICAS no longer displays this information.

[14] The cabin altimeter is the primary gauge for the pressurization system when it is being operated in manual mode.

[15] The cabin vertical speed indicator and the cabin differential pressure indicator are located directly below the cabin altimeter in the cockpit. The cabin vertical speed indicator displays the rate of change of the cabin altitude, while the cabin differential pressure indicator displays the difference in pressure between the cabin and the atmosphere.

lavatory A smoke detector,[16] its alarm was triggered with no smoke present[17] at a pressure level of 22.28 pounds per square inch absolute (psia),[18] which corresponds to a cabin altitude of -12,100 feet. However, because the cabin altimeter's negative range stops at -5,000 feet, the -12,100-foot cabin altitude would have registered on the cabin altimeter in the high end of the positive range, indicating a cabin altitude of approximately 19,000 feet. This would have presented the flight crew with a misleading indication of a high cabin altitude (indicating low cabin pressure) when, in fact, the cabin was pressurized well above ambient pressure. This high cabin altitude indication would likely have confused the flight crew because it would have appeared that the actions that they had taken to manually pressurize the airplane after recognizing the malfunctioning pressurization system were not being properly reflected in the cabin altimeter reading.[19]

The Safety Board is concerned that the cabin altimeter gauges on all A300 airplanes may present flight crews with misleading information about the airplane's cabin altitude and pressure, particularly when the pressurization system is malfunctioning and is being operated in the manual mode. The Board notes that if the cabin altitude were displayed in a digital display as opposed to a mechanical gauge, the display would likely have indicated the accurate cabin altitude of -12,100 feet. The Board further notes that a broader range of values on the cabin altimeter gauge (from -20,000 to 20,000 feet, as opposed to -5,000 to 20,000 feet) would also likely have resulted in an accurate indication of cabin altitude to the flight crew. Therefore, the Safety Board believes that the FAA should require that the cabin altimeter gauges on all Airbus Industrie A300 airplanes be modified to ensure that they will not give flight crews misleading indications about cabin altitude and pressure, particularly when the pressurization system is being operated in the manual mode. This could be accomplished either by the replacement of the gauge with a digital display, by the expansion of the values on the existing gauge design, or by other means.

The Safety Board is aware of a similar overpressurization event that occurred on December 3, 2000, on a Boeing 737 (737) airplane. During that event, the flight crew was presented with a 20,000-foot cabin altitude reading on the cabin altimeter (indicating low cabin pressure) at 7,000 feet during descent when, in fact, the cabin was overpressurized. The flight crew, believing that the cabin altitude reading was accurate, selected the manual mode of the pressurization system[20] and commanded the outflow valves to the closed position to correct the (perceived) high cabin altitude.[21] In response to these adjustments, the flight crew saw the cabin altimeter indicate a lower cabin altitude (which was the desired response), but the cabin actually continued to overpressurize. The flight crew circled the destination airport while troubleshooting

---

[16] The investigation determined that, because lavatory A is immediately adjacent to the cockpit, the sounding of its smoke detector was most likely what the CVR recorded.

[17] The Safety Board will discuss the operation of the lavatory smoke detectors later in this letter.

[18] Psia is pressure as measured from a vacuum condition.

[19] The CVR recording indicates that the flight crew discussed confusing cabin altitude readings for approximately 3.5 minutes before the smoke detector alarm was recorded.

[20] The flight crew indicated that it selected the manual pressurization mode since the automatic systems were not able to control the cabin pressure adequately.

[21] Commanding the outflow valves closed drives a high cabin altitude (low pressure) towards a lower cabin altitude (higher pressure).

the problem; however, the cabin pressure did not equalize with the ambient pressure until after the aircraft landed and the outflow valves opened.[22]

The Safety Board notes that if the cabin altitude were displayed on a digital display or if the existing cabin altimeter gauge design had a broader range of values, the flight crew would likely have gotten an accurate cabin altitude reading. The Board is concerned that the potential to misinterpret an overpressure condition as a low pressure condition exists on all aircraft that do not have cabin altimeters that accurately display cabin altitude, particularly when the pressurization system is being operated in the manual mode. Therefore, the Safety Board believes that the FAA should conduct a survey of transport-category aircraft to determine which are equipped with cabin altimeters that are capable of displaying indications beyond the marked ranges of the gauge and require that the cabin altimeter gauges on those airplanes be modified to ensure that they will indicate the correct cabin altitude to the flight crew, particularly when the pressurization system is being operated in the manual mode. This could be accomplished either by the replacement of the gauge with a digital display, by the expansion of the values on the existing gauge design, or by other means.

Lavatory Smoke Alarms

The captain reported that during the November 20, 2000, accident flight, the lavatory smoke detector alarms sounded continually while the aircraft was returning to MIA. On final approach, the loop B cargo compartment smoke detector indicated a loop fault.[23] The flight crew indicated in postaccident interviews that it ordered the emergency evacuation because it believed that the smoke detector alarms, in conjunction with the cargo compartment loop light, indicated a possible fire.

The investigation revealed that the Airbus A300 lavatory and cargo compartment smoke detectors are ionization-type detectors whose sensitivity is affected by ambient pressure. When the ambient pressure level elevates beyond a certain point, which varies with each detector, the lavatory and cargo compartment smoke detectors sound their alarms when no smoke is present. The Safety Board reviewed the qualification requirements for aircraft smoke detectors and found that Technical Standard Order (TSO)-C1c, "Cargo Compartment Fire Detection Instruments," which was issued by the FAA on July 10, 1987, applies to aircraft cargo compartment smoke detectors on all transport-category aircraft; however, no TSO exists for aircraft lavatory smoke detectors on transport-category aircraft. The TSO for the cargo compartment smoke detectors contains requirements for proper operation at elevated pressure levels up to 24.5 psia. Therefore, a properly functioning cargo compartment smoke detector would likely not provide an erroneous indication of smoke or fire at elevated pressure levels, so long as those levels are lower than those specified by the TSO.[24]

---

[22] The reason for the opening of the outflow valves after landing could not be determined. Neither the 737 nor the A300 has a design feature that automatically opens the outflow valves upon landing when the pressurization system is in the manual mode.

[23] The illumination of a loop fault light indicates that one smoke detector (out of two in the loop) has triggered its alarm, but the other detector has not and that a fire may (or may not) exist in the cargo compartment. The cargo compartment smoke detector does not sound an alarm if one loop fault light is lit.

[24] Although the TSO for the cargo compartment smoke detector requires proper operation of the smoke detector at pressure levels above those experienced on the accident flight, the accident airplane's cargo compartment smoke

The aural and visual false alarms generated by the lavatory smoke detectors on the November 20, 2000, accident flight added unnecessarily to the workload of the flight and cabin crew and caused the flight crew to order an emergency evacuation. The Safety Board is concerned that unnecessary emergency evacuations may be conducted if lavatory (and other ionization-type) smoke detectors are activated at higher pressure levels in the absence of smoke. This could be avoided if they were held to the same technical standards as cargo compartment smoke detectors. Therefore, the Safety Board believes that the FAA should require that all ionization-type smoke detectors (including lavatory smoke detectors) on newly manufactured transport-category aircraft adhere to the technical standards in TSO-C1c for cargo compartment smoke detectors. Further, the Safety Board believes that the FAA should require that, within 5 years, all ionization-type smoke detectors (including lavatory smoke detectors) on existing transport-category aircraft meet the same technical standards in TSO-C1c for cargo compartment smoke detectors.

The investigation also revealed that neither the Airbus nor the American Airlines A300 flight crew operating manual contains information about the possibility of elevated pressure levels triggering the sounding of ionization-type smoke detectors. If the flight crew had known about the possibility of smoke detectors sounding at higher pressure levels, the flight crew may have been able to consider this information in their troubleshooting actions. The Board does not want to diminish the importance of taking immediate action in response to a fire warning of any type. However, if pilots of all aircraft with ionization-type smoke detectors were informed of the potential for false alarms in overpressure situations, they might be able to quickly determine whether an alarm is due to smoke or an overpressurization event. Therefore, the Safety Board believes that, until all existing aircraft have been retrofitted with ionization-type smoke detectors that are TSO-compliant, the FAA should require that the operating manuals of all transport-category aircraft, including the Airbus Industrie A300, that are equipped with ionization-type smoke detectors (including lavatory smoke detectors) that are not TSO-compliant state that overpressure conditions may lead to false alarms from those detectors. However, it should remain clear that immediate action in response to the fire warning is necessary until an overpressurization condition is verified.

According to the November 20, 2000, accident flight's cabin crew, confusion was caused by the multiple lights and audible signals generated by the lavatory smoke detectors when their alarms were triggered during the return to MIA. The investigation determined that the following lights and audible signals were generated on the November 20, 2000, accident flight (and are typically generated on the A300 upon the triggering of a lavatory smoke alarm):

- The red light on the smoke detector was illuminated;
- A repetitive audible tone was emitted from the smoke detector;
- A red warning light on the lavatory wall blinked;
- The red SMOKE LAV (smoke lavatory) warning light on the forward flight attendant's panel blinked;

---

detector was malfunctioning and caused the loop light to illuminate on the CARGO COMPT SMOKE DET panel in the cockpit. The Safety Board has not determined why the cargo compartment smoke detector malfunctioned in this accident, but it appears to be an isolated incident.

- The red SMOKE LAV warning light on the aft flight attendant's panel blinked;
- A repetitive HI/LO (high/low) chime was broadcast in the cabin;
- The white CAPT CALL lights at the flight attendant telephone stations came on;
- The green lights on the flight attendant telephone station keypads came on;
- The area red call lights on the ceilings in the aisles blinked;
- The amber area call lights on the ceilings in the aisles blinked, indicating in which lavatory the alarm was located.

The investigation revealed that some of the visual signals generated by the lavatory smoke alarm were not helpful in directing the cabin crew to the source of the alarm. Specifically, the white CAPT CALL lights and the green keypad illuminations on the flight attendant telephone stations are indications used for other purposes, including indicating a call from the captain to the flight attendants. Generated by the lavatory smoke alarm, these illuminations led the cabin crew to believe that the flight crew was trying to call rather than alert the cabin crew to potential smoke in a lavatory. The cabin crewmembers were distracted from their duties during the return to MIA when they attempted to answer the (perceived) call from the flight crew and found that the flight crew was not on the telephone. If a fire had existed on the accident airplane, the confusion generated by the CAPT CALL and green keypad illuminations could have wasted valuable time. The Safety Board is concerned that the CAPT CALL and the green keypad illuminations associated with the lavatory smoke detector alarm function on Airbus A300 airplanes do not provide relevant information about a potential fire hazard and could potentially distract flight and cabin crews from their duties during flight or during an evacuation. Therefore, the Safety Board believes that the FAA should require that all operators of Airbus Industrie A300 airplanes eliminate the CAPT CALL light and the green keypad illuminations from the lavatory smoke detector alarm function. Further, the Safety Board believes that the FAA should require that, on all future Airbus Industrie A300 airplanes, the CAPT CALL light and the green keypad illuminations are not included in the lavatory smoke detector alarm function.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Require that the cabin altimeter gauges on all Airbus Industrie A300 airplanes be modified to ensure that they will not give flight crews misleading indications about cabin altitude and pressure, particularly when the pressurization system is being operated in the manual mode. This could be accomplished either by the replacement of the gauge with a digital display, by the expansion of the values on the existing gauge design, or by other means. (A-02-26)
>
> Conduct a survey of transport-category aircraft to determine which are equipped with cabin altimeters that are capable of displaying indications beyond the marked ranges of the gauge and require that the cabin altimeter gauges on those airplanes be modified to ensure that they will indicate the correct cabin altitude to the flight crew, particularly when the pressurization system is being operated in the manual mode. This could be accomplished either by the replacement of the gauge with a digital display, by the expansion of the values on the existing gauge design, or by other means. (A-02-27)

Require that all ionization-type smoke detectors (including lavatory smoke detectors) on newly manufactured transport-category aircraft adhere to the technical standards in Technical Standard Order C1c for cargo compartment smoke detectors. (A-02-28)

Require that, within 5 years, all ionization-type smoke detectors (including lavatory smoke detectors) on existing transport-category aircraft meet the same technical standards in Technical Standard Order C1c for cargo compartment smoke detectors. (A-02-29)

Until all existing aircraft have been retrofitted with ionization-type smoke detectors that are technical standard order (TSO)-compliant, require that the operating manuals of all transport-category aircraft, including the Airbus Industrie A300, that are equipped with ionization-type smoke detectors (including lavatory smoke detectors) that are not TSO-compliant state that overpressure conditions may lead to false alarms from those detectors. (A-02-30)

Require that all operators of Airbus Industrie A300 airplanes eliminate the CAPT CALL light and the green keypad illuminations from the lavatory smoke detector alarm function. (A-02-31)

Require that, on all future Airbus Industrie A300 airplanes, the CAPT CALL light and the green keypad illuminations are not included in the lavatory smoke detector alarm function. (A-02-32)

Former Chairman Blakey, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

Original Signed

By: Carol J. Carmody
Acting Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 26, 2002

In reply refer to: H-02-23 through -25

Honorable Ellen G. Engleman
Administrator
Research and Special Programs Administration
U.S. Department of Transportation
400 Seventh Street, S.W.
Washington, D.C. 20590

About 2:15 p.m., central daylight time, on May 1, 2001, a northbound tractor, in combination with a semitrailer that had horizontally mounted cylinders filled with compressed hydrogen, which is a flammable gas, struck a northbound pickup truck that had veered in front of the tractor-semitrailer on U.S. Highway 75, 2 miles south of Ramona, Oklahoma. According to witnesses, the tractor-semitrailer then went out of control and overturned while continuing along the highway. It went off the road to the east and traveled 300 more feet before it stopped. During the process, some of the cylinders, valves, piping, and fittings at the rear of the semitrailer were damaged and released hydrogen. The hydrogen ignited and burned the rear of the semitrailer. In the meantime, the pickup truck had also run off the road. The pickup truck's fuel line ruptured, resulting in the truck being destroyed by fire.

As a result of the accident, the truckdriver was killed, and the driver of the pickup truck was seriously injured. Residents of five homes in the vicinity of the accident were asked to evacuate, and the highway was closed for more than 12 hours. Damage, cleanup, and lost revenues were estimated at $155,000.[1]

The National Transportation Safety Board determined that the probable cause of the May 1, 2001, collision and subsequent fire involving a tractor-semitrailer and a pickup truck in Ramona, Oklahoma, was the failure, for unknown reasons, of the pickup driver to control her vehicle. Contributing to the severity of the accident were the inadequate protection and shielding of the cylinders, valves, piping, and fittings and the inadequate securement of cylinders on the semitrailer.

Under the hazardous materials regulations (49 *Code of Federal Regulations* [CFR] 173.301), protection for valves and rupture disks for U.S. Department of Transportation specification cylinders horizontally mounted on semitrailers must be designed to "withstand a

[1] For additional information, see forthcoming Hazardous Materials Accident Report--*Release and Ignition of Hydrogen Following the Collision Between a Tractor/Semitrailer with Horizontally Mounted Cylinders and a Pickup Truck Near Ramona, Oklahoma, May 1, 2001* (NTSB/HZM-02/02).

force equal to twice the weight involved with a safety factor of four, based on the ultimate strength of the material used." Although the Research and Special Programs Administration (RSPA) has not issued a formal written interpretation of this requirement, RSPA staff has advised the Safety Board that the requirement applies only to a rear-end strike to the semitrailer. Many semitrailers have extended rear bumpers, and such bumpers may offer protection from rear strikes, but they afford no protection from the side and top forces that are typically encountered in a rollover accident.

The regulations do not specify whether the valves, piping, and fittings must be enclosed and shielded by a protective structure; and the regulations do not explain whether other options for protection, such as recessed valves and fittings, are acceptable. This lack of specificity in the regulations led one manufacturer of semitrailers with horizontally mounted cylinders to believe that the cabinet that encloses the valves, piping, and fittings is designed to protect them from being sheared or broken off. A second manufacturer believes that an extended rear bumper fulfills the requirements to protect valves and fittings. Another manufacturer stated that the cabinet must be constructed to comply with the requirements that apply to portable gas cylinders. There is no clear and concise requirement in the hazardous materials regulations that addresses the protection of valves and fittings from forces in a rollover accident. The absence of RSPA guidance has created differing perceptions within the industry about what is actually required for protecting valves, piping, and fittings on a semitrailer with horizontally mounted cylinders.

Because of the ambiguities of the existing regulations and the various interpretations among the manufacturers of the vehicles, the Safety Board concluded that the hazardous materials regulations do not provide sufficient and clear requirements for protecting cylinders and valves, piping, and fittings of cylinders that are horizontally mounted on semitrailers. Consequently, the hazardous materials regulations must address the multidirectional forces that these cylinders, valves, piping, and fittings may experience in a rollover accident. Therefore, the Safety Board believes that RSPA should modify 49 CFR 173.301 to clearly require that valves, piping, and fittings for cylinders that are horizontally mounted and used to transport hazardous materials are protected from multidirectional forces that are likely to occur during accidents, including rollovers.

Also, cylinder 3 on the accident vehicle was fractured by overstress resulting from the initial impact of the front of the cylinder on the roadway or terrain during the rollover of the vehicle, and the cylinder was ejected from the semitrailer. The cylinder was particularly vulnerable to absorbing the initial impact with the roadway or ground because its body extended beyond the top and side edges of the semitrailer's bulkheads. The hazardous materials regulations are silent regarding the protection and shielding of horizontally mounted cylinders on semitrailers from initial impact during rollover accidents. According to the manufacturers of semitrailers with horizontally mounted cylinders, the accident semitrailer was typical of other semitrailers in service. Consequently, the Safety Board concluded that because horizontally mounted cylinders on semitrailers typically extend beyond the envelope of the bulkheads, the cylinders are exposed and vulnerable to initial impact with the roadway or terrain during rollover accidents and are at increased risk of damage, failure, and ejection. Therefore, the Safety Board believes that RSPA should require that cylinders that transport hazardous materials and are horizontally mounted on a semitrailer be protected from impact with the roadway or terrain to reduce the likelihood of their being fractured and ejected during a rollover accident.

The emergency responders who are first to arrive at an accident scene often use the *North American Emergency Response Guidebook* as their first reference. The first responders to the Ramona accident used the book and referred to the guide for hydrogen. However, the guide did not provide complete information about the unique properties of hydrogen, specifically that hydrogen burns with an invisible, or almost invisible, flame. The guide also contained generic information about chemical properties, such as vapors sinking to the ground, which do not apply to hydrogen.

Incomplete or inaccurate information in the guidebook may lead first responders to take measures that endanger them. The Safety Board concluded that although the incomplete or inaccurate information about hydrogen in the *North American Emergency Response Guidebook* was not a factor in this accident, there is the possibility that the lack of information could increase the risk to emergency response personnel.

Consequently, the Safety Board believes that RSPA should revise the information about hydrogen in the *North American Emergency Response Guidebook* so that it specifically identifies the unique chemical and flammability properties of hydrogen.

Therefore, the National Transportation Safety Board makes the following safety recommendations to the Research and Special Programs Administration:

> Modify 49 *Code of Federal Regulations* 173.301 to clearly require that valves, piping, and fittings for cylinders that are horizontally mounted and used to transport hazardous materials are protected from multidirectional forces that are likely to occur during accidents, including rollovers. (H-02-23)
>
> Require that cylinders that transport hazardous materials and are horizontally mounted on a semitrailer be protected from impact with the roadway or terrain to reduce the likelihood of their being fractured and ejected during a rollover accident. (H-02-24)
>
> Revise the information about hydrogen in the *North American Emergency Response Guidebook* so that it specifically identifies the unique chemical and flammability properties of hydrogen. (H-02-25)

Please refer to Safety Recommendations H-02-23 through -25 in your reply. If you need additional information, you may call (202) 314-6177.

Acting Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

Original Signed

By: Carol J. Carmody
Acting Chairman

National Transportation Safety Board
Washington, D.C. 20594

Safety Recommendation

Date: September 26, 2002

In reply refer to: M-02-18

Admiral Thomas H. Collins
Commandant
U.S. Coast Guard
Washington, D.C. 20593-0001

About 1930 on January 4, 2001, the domestic high-speed vessel *Finest*, with 258 passengers, 5 crewmembers, and 1 company official on board, ran aground outside the Shrewsbury River channel to Sandy Hook Bay while en route from New York City, New York, to Highlands, New Jersey. The *Finest* refloated at 0007 on January 5, after the tide changed, and proceeded to Sandy Hook Bay Marina, where it docked at 0026 and discharged its passengers. No one on board the vessel suffered any injury, and the vessel sustained no damage. One person on board had to be evacuated from the vessel by helicopter for medical treatment of an allergic reaction unrelated to the accident.[1]

The National Transportation Safety Board determined that the probable cause of the grounding of the *Finest* was the failure of the vessel master to use appropriate navigational procedures and equipment to determine the vessel's position while approaching the Shrewsbury River channel. Contributing to the cause of the grounding was the lack of readily visible fixed navigational aids. Also contributing to the cause of the grounding was the failure of New York Fast Ferry (NYFF) to require the use of installed navigation equipment and to set guidelines for operations in adverse environmental conditions. Based on its investigation, the Safety Board identified safety issues in the following areas: adequacy of the navigational procedures; adequacy of navigational aids in the Shrewsbury River; and appropriateness of alcoholic beverage service after an accident.

The Coast Guard concluded in its 1992 Waterways Analysis and Management System study that while it was possible for vessels to navigate in the Shrewsbury River without navigational aids, to do so was "unsafe." Commercial operators in the river had requested larger fixed aids for the Shrewsbury River Channel, and, in 1993, the Coast Guard installed two beacons at the positions of buoys 2 and 3. During a winter storm, the beacons were damaged and the Coast Guard replaced them with buoys.

[1] For further information, read: National Transportation Safety Board, *Grounding of the Small Passenger Vessel* Finest, *Sandy Hook, New Jersey, on January 4, 2001*, Marine Accident Report NTSB/MAR-02/03 (Washington, DC: NTSB, 2002).

The lighted buoys in the Shrewsbury River channel are now replaced in the winter by smaller unlit buoys, which are less susceptible to ice damage. These smaller buoys, however, can be moved off station or forced under the ice, thereby leaving the channel inadequately marked. On the evening of the grounding, all of the channel buoys were obscured by ice. Without the aids, the master used visual observations of shore lights to make the final turn, something he did not normally do, and went aground.

Beacons are visible on radar and give the navigator precise reference points to use in navigating, regardless of conditions. Because radar is used for collision avoidance and, at the same time, can be used for navigation, the importance of maintaining a radar watch cannot be overstated. Beacons, quickly identifiable on radar, assist mariners by allowing them to navigate and to maintain a watch for other vessels at the same time.

Small passenger vessels were crucial to the evacuation of Manhattan on September 11, 2001. Because of their speed, in a time of disaster, high-speed vessels could evacuate large numbers of people from New York City. The potential use of high-speed vessels in such circumstances makes the provision of reliable navigational aids all the more critical.

The Safety Board considered whether the placement of ranges would help vessels transit the channel. Ranges are ineffective in conditions of reduced visibility. Beacons that are permanently installed at the entrance to a channel, however, will not be hidden by ice and can be identified by radar in fog. Based on its findings in this accident, the Safety Board concluded that the safety of navigation in the Shrewsbury River channel would be enhanced by the installation of navigational aids that are available for use in all conditions of visibility.

The National Transportation Safety Board, therefore, makes the following safety recommendation to the U.S. Coast Guard:

> Install beacons to augment or replace buoys at the entrance to the Shrewsbury River channel. (M-02-18)

As a result of this investigation, the Safety Board also issued safety recommendations to New York Fast Ferry. The Safety Board would appreciate a response from you within 90 days addressing actions you have taken or intend to take to implement our recommendation. In your response to the recommendation in this letter, please refer to M-02-18. If you need additional information, you may call (202) 314-6177.

Acting Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Carol J. Carmody
Acting Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 26, 2002

In reply refer to: M-02-19 through -21

Mr. John Koenig
President
New York Fast Ferry
52 Shrewsbury Avenue
Highlands, New Jersey 07732

The National Transportation Safety Board (Safety Board) is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge you to take action on the safety recommendations in this letter. The Safety Board is vitally interested in these recommendations because they are designed to prevent accidents and save lives.

The three recommendations address the requirements for crewmember navigational proficiency, the operating standards for navigation in adverse conditions, and the policies for alcoholic beverage service during emergency situations. The recommendations are derived from the Safety Board's investigation of the grounding of the *Finest* outside the Shrewsbury River channel to Sandy Hook Bay on January 4, 2001, and are consistent with the evidence we found and the analysis we performed.[1] As a result of this investigation, the Safety Board also issued a safety recommendation to the U.S. Coast Guard. The Safety Board would appreciate a response from you within 90 days addressing actions you have taken or intend to take to implement our recommendations.

Based on its investigation, the National Transportation Safety Board determined that the probable cause of the grounding of the *Finest* was the failure of the vessel master to use appropriate navigational procedures and equipment to determine the vessel's position while approaching the Shrewsbury River channel. Contributing to the cause of the grounding was the lack of readily visible fixed navigational aids. Also contributing to the cause of the grounding was the failure of New York Fast Ferry (NYFF) to require the use of installed navigation equipment and to set guidelines for operations in adverse environmental conditions.

[1] For further information, read: National Transportation Safety Board, *Grounding of the Small Passenger Vessel* Finest, *Sandy Hook, New Jersey, on January 4, 2001*, Marine Accident Report NTSB/MAR-02/03 (Washington, DC: NTSB, 2002).

On a typical approach to the Sandy Hook Bay Marina (SHBM), the navigator would set the vessel's course for the Shrewsbury River channel after passing buoy 17 and Sandy Hook Point. He would look for the channel buoys visually and attempt to locate the buoys on his radar. The SHBM also presented a distinct target on the radar. The navigator could set the vessel's course in the approximate direction of the channel buoys and the SHBM. Because the bay was sufficiently deep and broad, the navigator would not be required to maintain a precise trackline until he neared the entrance to the channel. After the navigator had sighted the entrance buoys visually, he would make course adjustments into the channel using the buoys as references. The distance from buoy 17 to buoy 2 (at the entrance to Shrewsbury River) is 3 1/2 miles. At 30 knots, it would take less than 8 minutes for the vessel to travel from buoy 17 to buoy 2.

During the trip that the vessel grounded, the master chose to deviate from his normal approach to avoid an ice field. Instead of a direct course (165° true) from buoy 17 to the channel, the master headed the vessel in a southerly (180° true) direction toward the Atlantic Highland breakwater and made the approach to the Shrewsbury channel from the west. To enter the channel, the master had to make a 90° starboard turn without the use of the buoys as references. He had sufficient electronic navigation equipment available to him to execute the maneuver safely.

At the point where he entered the ice field, the approximate distance to the position of buoy 2 was 6/10 mile. The master operated toward the estimated position of buoy 2 at a speed of about 32 to 34 knots and continued to look for the approach buoys visually and by radar. When the vessel was approximately 3/10 mile from channel approach buoy 2, the master began reducing his speed to about 25 knots. He made one final attempt to locate the buoys by having the deckhand go on the bridge wing to obtain a visual sighting. The master then made his turn toward the SHBM based on a visual observation of the SHBM's lights and a radar observation of the SHBM. Attempting this maneuver at such a high speed was not prudent.

At the postaccident interview, the master was asked what could he do differently in the future to avoid grounding the vessel if faced with the same circumstances. He recommended that the Coast Guard break up the ice or have a range installed. He also recommended that the company have an alternate landing site. When asked whether there was an alternative to using the buoys to enter the marina, he stated that he did not know of an alternative.

There were alternative methods of navigation that the master could have used to safely navigate the vessel into the marina. He could have set his radar's variable range marker (VRM) to a range of 1/2 mile to serve as a danger marker. As he approached Sandy Hook Peninsula on his trackline, the distance to the land would close or decrease and would be readily apparent on the radarscope. When the distance to land was 1/2 mile, the range ring would appear to be tangent to the landmass, and the vessel would be at the turning point. If the vessel continued toward the land without changing course, the range ring would pass over the land, indicating that the distance was less than 1/2 mile from the vessel and that, as a result, the vessel was approaching shallow water.

The master could have also determined the true course line of the channel and adjusted his electronic bearing line (EBL) to display either the true or relative bearing from his easterly heading. At the point that the EBL was aligned into the marina, when the VRM became tangent with the landmass, the master would know that the vessel was at the point where it was safe to head toward the SHBM.

The master could also have used a prominent shoreline point to obtain a fix base on the range and bearing to that point. The Atlantic Highlands breakwater light would have provided a prominent mark for the master to fix the vessel's position. Another option that the master could have used to determine the vessel's position was the PinPoint chart plotter with the appropriate global positioning system (GPS) input. Had the master used radar range and bearing or the GPS with the PinPoint chart plotter, he could have established the vessel's position and navigated into the marina without incident.

The master had a radar, a GPS, a paper chart, and an electronic chart available to use to establish the vessel's position. The master could have successfully made the Shrewsbury River transit by using the navigational equipment that was available to him.

The master had never made an approach into the channel when all of the buoys were obscured by ice. On the trip before the grounding, buoy 2 was the only aid visible. Moreover, the master had adequate warning from the *Light List* and the "Broadcast Notice to Mariners" that ice might obscure all of the buoys. The master had traveled the route for months before the night of the grounding. He had ample opportunity to use alternate forms of navigation with the equipment available to him.

Because he did not have an alternate plan before entering the ice field, the master should have taken precautions by devising a plan before approaching the channel. As discussed earlier, his radar could have provided him with the information necessary to establish his position. However, the master continued at the service speed of 32 to 34 knots until he had entered the ice and proceeded to the channel entrance without establishing his position. He relied on visually locating the obscured buoys up until the vessel made the final turn toward the marina.

A vessel's position can be established by plotting information that is determined by radar. The range and bearing to a distinctive landmark or fixed navigational aid is an effective tool for establishing a vessel's position. However, information from the radar must be transferred onto a nautical chart that, depending on the proficiency of the navigator, can take 30 to 60 seconds to accomplish. In pilotage waters, the situation can change rapidly, and the navigator might only be able to use the chart as a guide and not have the time to transfer the radar information to the chart. A vessel traveling at 30 knots advances 1/2 mile per minute. Therefore, if the master had attempted to establish his position by plotting the radar information without slowing down, the vessel would have traveled beyond the turning point and been in shallow water before the master could assess and react to the information and turn the vessel. Further, the existing conditions, including the operations at night, the presence of ice, the lack of floating aids to navigation, and the master's unfamiliarity with the attempted turn maneuver, all demanded a more cautious approach to the turn point at the entrance to the Shrewsbury channel. Prudence should have dictated that the master approach the turn at a slower speed. The master was going too fast to permit him to safely approach the entrance to the Shrewsbury River channel under the prevailing conditions.

Because it would have taken some time to plan and execute his approach, the master should have reduced speed once he could not locate the buoys visually or identify them on radar. After reducing his speed, the master should have determined his position either by plotting a radar range and bearing or by using the GPS and the electronic chart. Maintaining speeds in excess of 25 knots and relying on visual observations with only limited use of other navigational aids is not prudent when attempting to turn into a narrow channel in a situation in which the vessel's position is not established.

The master had completed a radar course that included instruction in radar navigation. However, proficiency in radar navigation is a skill that is developed from hands-on experience. The principles can be introduced in a classroom environment or with a simulator, but the radar must be used in routine conditions so that the navigator can call upon the skill when needed as circumstances change. The master did not use the PinPoint chart plotter and did not consider using it on the night of the accident. The chart plotter, like radar, buoys, and fixed structures are all navigational aids that should be used, when appropriate, by the prudent mariner. The master of the *Finest*, by his actions and by his answers to interview questions, indicated that he relied primarily on buoys and visual observations to navigate. He used the radar solely as an extension of his eyes for early warning. The observations that he took from the radar were approximations and not measured bearing or ranges. Because the master did not train on or use all the available navigational equipment in routine conditions, he may not have been prepared to use the equipment on the night of the grounding when conditions were not routine.

The Coast Guard and the high-speed small passenger vessel industry have approached the issue of operational safety of high-speed vessels as "partners." The partnership hopes to improve safety by relying on a voluntary versus a regulatory approach. The Coast Guard has issued Navigation and Vessel Inspection Circulars that serve as guidelines to the industry to improve safety. In theory, the company, by joining in the partnership, is supposed to improve the safe operation of its vessels through voluntary action without having burdensome regulations imposed upon it. One such improvement would be to ensure that people are capable of using all the navigational equipment on the ship.

The company hired the master and was responsible for ensuring that the he was prepared to use all of the equipment available to ensure a safe operation. Before the master was promoted, the company's port captain made a few check rides with the master. However, the company did not evaluate the master in the use of the on-board navigational equipment. The company also did not make subsequent evaluations of the master to determine whether he was proficient in the use of all the available navigational equipment. If NYFF had ensured that the master and senior deckhands operating in the capacity of navigator were trained on and used the installed navigational equipment to proficiency, the grounding would not have occurred. Therefore, the Safety Board believes that the NYFF should establish and implement requirements that vessel masters and crewmembers with navigational responsibilities use to proficiency all installed vessel navigation equipment and institute procedures to periodically monitor their performance.

The NYFF did not have any standard operating requirements for the navigation of its vessels in adverse environmental conditions. In the Safety Board's opinion, the safe navigation of company vessels is as much a responsibility of the company management officials as it is the master of the vessel. To discharge its responsibility, the company should establish minimum operating standards for conducting navigation watches and for specifying actions to be taken by vessel operating crewmembers during periods of adverse environmental conditions. At a minimum, company officials should specify the minimum frequency of navigation fixes and the maximum speeds of advance during adverse conditions and require the use of electronic navigation equipment whenever the environmental conditions deteriorate to reduced visibility from any cause or result in any condition, such as ice, that precludes the use of visual aids to navigation. Had NYFF enforced such operating standards for some time before this accident, the master would have been required to proceed at a slower speed and would have been acclimated to the use of the electronic navigation equipment provided. Had this occurred, this accident might have been avoided. The lack of vessel operating standards for navigation in adverse environmental conditions played a decisive role in the vessel's grounding. The Safety Board, therefore, believes that the NYFF should establish and implement vessel operations standards for navigation in adverse environmental conditions, including fog, snow, heavy rain, and ice.

After the grounding, shoreside vessel management initiated an "open bar" as a means of compensating the passengers for the delay. This gesture included all items at the snack bar, including alcoholic beverages. Complimentary beverage service is a relatively common action in the food service industry as compensation for poor or interrupted service. However, unrestricted alcoholic beverage service could have created a serious problem in this situation. According to the Coast Guard report of this accident:

> It [the postaccident open bar] presented a safety concern that now had to be factored into the planning. We wanted to avoid a situation where we now had inebriated passengers to rescue. This became a grave concern, and if it became necessary, prohibited the USCG from using helos [helicopters] or other assets if feasible.

The Safety Board concurs with this assessment. Throughout the small passenger vessel industry, efforts aimed at customer satisfaction and appeasement must be balanced against the risk to passenger safety. Continued service of alcoholic beverages after an accident creates a potential crowd management problem. While this problem has not been identified in previous Safety Board investigations, the Safety Board feels that it is an important safety issue. These vessels can carry many hundreds of passengers with crews of varying size, depending on what their certification requires. For example, the *Finest* was certified to carry up to 389 passengers with 6 crewmembers, including a master and mate (or senior deckhand). Because the master and mate are responsible for controlling the vessel, that would leave only four deckhands to manage almost 400 people during an emergency. With a ratio of deckhands to passengers of almost 1 to 100, it would take very few inebriated passengers to overwhelm the ability of the crewmembers to maintain control. This is especially likely because the deckhands on the *Finest* had no training in crowd control management.

The situation on the *Finest* is not unique. All small passenger vessels face the potential of having to deal with an emergency in which the ratio of crewmembers to passengers is very low, in many cases much lower than 1 to 100. Similarly, most deckhands on small passenger vessels are not trained in crowd control management. This raises serious concerns about the ability of such crewmembers to control of inebriated passengers during emergency situations. Serving alcoholic beverages in emergency situations is not a prudent action. Therefore, the Safety Board believes that the NYFF should establish a company policy requiring the cessation of alcoholic beverage service during emergency situations and that policy should be included in its vessel operating manual.

The National Transportation Safety Board, therefore, makes the following safety recommendations to New York Fast Ferry:

> Establish and implement requirements that vessel masters and crewmembers with navigational responsibilities use to proficiency all installed vessel navigation equipment and institute procedures to periodically monitor their performance. (M-02-19)
>
> Establish and implement vessel operations standards for navigation in adverse environmental conditions, including fog, snow, heavy rain, and ice. (M-02-20)
>
> Establish a company policy requiring the cessation of alcoholic beverage service during emergency situations and include that policy in your Vessel Operating Manual. (M-02-21)

In your response to the recommendations in this letter, please refer to M-02-19 through -21. If you need additional information, you may call (202) 314-6177.

Acting Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Carol J. Carmody
Acting Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 26, 2002

In reply refer to: M-02-22

Mr. Tim Solso
Chairman and Chief Executive Officer
Cummins, Inc.
500 Jackson Street
Columbus, Indiana 47201

The National Transportation Safety Board (Safety Board) is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge you to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

The recommendation addresses the adequacy of the instructions for the installation of engine accessories. The recommendation is derived from the Safety Board's investigation of the fire on board the high-speed domestic vessel *Seastreak New York* near Sandy Hook Point, New Jersey, on September 28, 2001, and is consistent with the evidence we found and the analysis we performed.[1] As a result of this investigation, the Safety Board has issued safety recommendations to Cummins Engine Company, Inc., and Circle Navigation Company of New York. The Safety Board would appreciate a response from you within 90 days addressing actions you have taken or intend to take to implement our recommendation.

The National Transportation Safety Board determined that the probable cause of the fire on board the *Seastreak New York* was the improper installation of the Centinel System's lube oil hose, which allowed the hose to come in contact with the hot exhaust manifold. Contributing to the cause of the fire was the absence of detailed guidance from the manufacturer of the Centinel System on the proper installation of the system. Also contributing to the cause of the fire was the lack of inspection and maintenance procedures by Circle Navigation Company that might have discovered the improper installation.

[1] For further information, read: National Transportation Safety Board, *Fire On Board the Small Passenger Vessel* Seastreak New York, *Sandy Hook Point, New Jersey, September 28, 2001*, Marine Accident Report NTSB/MAR-02/04 (Washington, DC: NTSB, 2002).

The fire damage to engine No. 3 precluded Safety Board investigators from identifying all possible failure mechanisms. Investigators, therefore, examined engine No. 1, which according to Circle Navigation, had been configured similarly to engine No. 3. They found that the lube oil hose was routed from the oil filter assembly at the rear starboard side of the engine over the top of the engine and underneath the cooling water hoses leading to the cooling jacket. The lube oil hose then led to the control valve on the front port side of the engine. The hose was not secured to any point in this area. Investigators found that this routing and the failure to secure the hose above the engine had allowed the lube oil hose on engine No. 1 to slip down past the forward edge of the cooling shield during installation or operation. The hose was found resting on or very near the hot exhaust manifold of engine No. 1.

The Safety Board is convinced that the lube oil hose was routed similarly on engine No. 3. When investigators examined engine No. 3 after the fire, they found no evidence that the hose had been secured. They found that one end of the broken lube oil hose was resting on top of the engine's exhaust manifold cooling shield and the other end of the hose was underneath the cooling shield, resting near the forward edge of the exhaust manifold.

In the absence of any securing of the lube oil hose in the space underneath the cooling water hoses, the vibrations of engine No. 3 could have provided the mechanism for the migration of the hose from its original position to the hazardous location below the exhaust manifold cooling shield and on or near the forward edge of the exhaust manifold, where the oil hose was subject to heat stress that eventually caused it to fail.

The Cummins Engine Company's documentation for the Centinel System does not contain any guidance for routing the lube oil hose from the oil filter assembly around heat sources to the control valve. Installation instructions in the hose manufacturer's catalog states, "When hose lines pass near an exhaust manifold or other heat source, they should be insulated by a heat resistant boot, fire sleeve, or a metal baffle." Based on its findings, the Safety Board concluded that the lack of guidance for the proper installation of the lube oil hose resulted in the lube oil hose on engine No. 3 being improperly routed and not secured, allowing it to migrate to the forward edge of the exhaust manifold, where it was subject to unintentional heat stress that eventually caused the hose to fail.

The National Transportation Safety Board, therefore, makes the following safety recommendation to Cummins Engine Company, Inc.:

> Revise your manufacturing and installation literature for the Centinel System to specify how to safely route and secure the lube oil hose between the oil filter assembly and the control valves on the engines. (M-02-22)

In your response to the recommendation in this letter, please refer to M-02-22. If you need additional information, you may call (202) 314-6177.

Acting Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

Original Signed

By: Carol J. Carmody
Acting Chairman

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 26, 2002

In reply refer to: M-02-23 and -24

Mr. Gus N. Markou
Director of Marine Operations
Circle Navigation Company of New York
World Yacht Marina, Pier 81
West 41st Street at the Hudson River
New York, New York 10036

The National Transportation Safety Board (Safety Board) is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge you to take action on the safety recommendations in this letter. The Safety Board is vitally interested in these recommendations because they are designed to prevent accidents and save lives.

The recommendations address the adequacy of crewmember training in marine firefighting and company maintenance and inspection procedures. The recommendations are derived from the Safety Board's investigation of the fire on board the high-speed domestic vessel *Seastreak New York* near Sandy Hook Point, New Jersey, on September 28, 2001, and are consistent with the evidence we found and the analysis we performed.[1] As a result of this investigation, the Safety Board has issued safety recommendations to Cummins Engine Company, Inc., and Circle Navigation Company of New York. The Safety Board would appreciate a response from you within 90 days addressing actions you have taken or intend to take to implement our recommendation.

The National Transportation Safety Board determined that the probable cause of the fire on board the *Seastreak New York* was the improper installation of the Centinel System's lube oil hose, which allowed the hose to come in contact with the hot exhaust manifold. Contributing to the cause of the fire was the absence of detailed guidance from the manufacturer of the Centinel System on the proper installation of the system. Also contributing to the cause of the fire was the lack of inspection and maintenance procedures by Circle Navigation Company that might have discovered the improper installation.

---

[1] For further information, read: National Transportation Safety Board, *Fire On Board the Small Passenger Vessel* Seastreak New York, *Sandy Hook Point, New Jersey, September 28, 2001*, Marine Accident Report NTSB/MAR-02/04 (Washington, DC: NTSB, 2002).

In this accident, deckhand No. 4 discovered the fire and acted instinctively to try to extinguish it using the nearby portable CO_2 extinguisher. His first action, however, should have been to notify the master before attempting to control the fire.[2] Training indicates that the proper procedures would have been to call the master on the telephone that was located in the engineroom. This would have given the master the opportunity to shut down the engine, either remotely or by directing deckhand No. 4 to do so locally. With the engine secured, the hose would no longer have been pressurized, and the flare-up may not have occurred or, at least, might have been greatly reduced. This could have lessened the severity of the emergency, and, possibly, instead of a fire igniting, an engine failure might have occurred.

After deckhand No. 4 retrieved the portable extinguisher, he pulled its safety pin and moved toward the fire. He did not check to see whether the extinguisher was operational by making a quick discharge. Checking the extinguisher in this manner before approaching a fire is critical to ensuring personal safety. Attacking a fire only to discover that the extinguisher is not operational creates a serious personal risk.

Had deckhand No. 4 been overcome by the flare-up and unable to exit the engine room, the situation could have been worse. The *Seastreak New York* carried no fire protection equipment (including SCBA[3]) for personnel and no such equipment was required. Entry into the burning engineroom by another crewmember would not have been possible. The crewmembers would have been faced with the choice of either closing the engineroom and using the CO_2, which probably would have killed deckhand No. 4, or leaving the engineroom open, which could have allowed the fire to spread to the passenger cabins.

As the deckhand evacuated the engineroom, he believed his clothes were on fire and planned to jump into the water to extinguish the fire. If the deckhand had jumped overboard, the crewmembers' attentions would have in all likelihood been focused on responding to the man overboard. The delay in securing the access hatch and responding to the fire could have created a situation in which the fire would have spread to the passenger cabins. If the deckhand who left the engineroom had collapsed after securing the space and had not prevented deckhand No. 1 from reopening the access doors to the space, a sudden introduction of additional oxygen could have caused the fire to flash and could have resulted in the fire spreading to the passenger cabins. Had the fire spread into the passenger cabins, the risk to passengers and crewmembers would have been a greatly increased. Smoke would have filled most if not all of the passenger cabins. The primary area of refuge from the smoke would have been the exterior third deck. The quick movement of 198 passengers to that space would have been difficult and hazardous. Without proper training in firefighting, it is doubtful that the crewmembers could have prevented the spread of the fire. Based on the crewmembers' actions and the potential ramifications of their response, the Safety Board concluded that while the fire was

---

[2] "The first actions are to sound the alarm and report the fire location...Do not attempt to extinguish a fire, however small it may seem, until sounding the alarm by voice, telephone, pull box, etc." Barbara Adams, *Marine Fire Fighting* (Stillwater, Oklahoma: Fire Protection Publications, 2000) p. 241.

[3] Self-Contained Breathing Apparatus.

successfully extinguished, the crew's lack of training could have negatively impacted passenger safety.

Once deckhand No. 4 had exited from the engineroom, the crewmembers followed the proper procedures as far as physical actions required before activating the fixed fire suppression system. They closed the access hatches, secured the ventilation dampers and the blower, shifted the electrical load to the port generator, and secured the fuel to all equipment in the engineroom. However, there was some confusion about getting permission from the master before activating the CO_2 release. Deckhand No. 4 was unaware that he needed to get permission to activate the system. Accepted industry practice is as follows: "When to use a fixed fire suppression system is an important decision that the designated officer in charge of fire control must make after becoming well informed of the situation and its surrounding circumstances."[4] On the *Seastreak New York*, this officer was the master. If the fire suppression system is activated without the master's knowledge or permission, it may adversely affect the results of decisions and actions he is directing. If he were to direct that an engineroom hatch be opened after the CO_2 was discharged, it would negate the effectiveness of the CO_2. The CO_2 would also be hazardous, possibly fatal, to anyone entering the engineroom.

New York Waterway, another company that operates commuter ferries in the metropolitan New York area, has voluntarily provided formal firefighting training to its marine crews. This shows that companies can take action to improve fire safety on their vessels without having to wait for the development of regulations requiring them to do so. Firefighting training is critical, not only for the safety of the vessels and crews, but also for the safety of the passengers. The actions of the crewmembers of the *Seastreak New York* in this fire show that Circle Navigation Company marine personnel lacked adequate firefighting training. Consequently, the Safety Board believes that Circle Navigation Company should develop and implement a training program in marine firefighting for its crewmembers.

The *Seastreak New York* had been in service less than 6 months when this fire occurred. Although there could be a reasonable expectation that components should not fail in such a short period, attachments to engines are subject to vibration, abrasion, and heat and may be vulnerable to failure long before the manufacturer's recommended replacement date. Attachments such as hoses are particularly vulnerable and should be visually inspected frequently and regularly to ensure that they are not subject to stresses that could materially lessen their service life. The condition of hoses is particularly important because they typically hold flammable liquids under pressure and if the hose fails for any reason, the likelihood of fire is very high. As can be seen from this accident, even relatively new hoses can fail, if the conditions are appropriate.

A comprehensive maintenance and inspection program should start when the vessel is delivered to the owner and should include frequent inspections of the condition, routing, and securing of hoses to the main engine and to other operating diesel engines. If a comprehensive inspection program had been in place at Circle Navigation, the hose

[4] Adams, p. 201.

resting on the manifold would probably have been identified and the hose rerouted and secured before the hose ruptured, and this fire could have been avoided. The lack of a preventive maintenance and inspection program set the stage for this fire to occur.

As discussed in the Safety Board's report on the fire on the *Port Imperial Manhattan*, the airline, rail, and motor carrier industries require preventive maintenance programs.[5] As a result of the *Port Imperial Manhattan* fire, the Safety Board recommended (Safety Recommendation M-02-5) that the Coast Guard require that companies operating domestic passenger vessels develop and implement preventive maintenance programs for all systems affecting the safe operation of their vessels, including the hull and the mechanical, and electrical systems. At the time of this writing, the Safety Board is still awaiting the Coast Guard's response to this recommendation. However, recognizing that the Coast Guard rulemaking requiring preventive maintenance programs is likely to be a time-consuming process, the Safety Board believes that, in the interim, Circle Navigation should develop and implement a preventive maintenance and inspection program for systems affecting the safe operation of its vessels, including the hull and the mechanical and electrical systems.

The National Transportation Safety Board, therefore, makes the following safety recommendations to Circle Navigation Company of New York:

> Develop and implement a training program in marine firefighting for your crewmembers. (M-02-23)
>
> Develop and implement a preventive maintenance and inspection program for systems affecting the safe operation of your vessels, including the hull and the mechanical and electrical systems. (M-02-24)

In your response to the recommendations in this letter, please refer to M-02-23 and -24. If you need additional information, you may call (202) 314-6177.

Acting Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

Original Signed

By: Carol J. Carmody
Acting Chairman

---

[5] National Transportation Safety Board, *Fire On Board the Small Passenger Vessel* Port Imperial Manhattan, *Hudson River, New York City, New York, November 17, 2000.* NTSB/MAR-02-02 (Washington, D.C.: NTSB, 2002).

National Transportation Safety Board
Washington, D.C. 20594

Safety Recommendation

Date: September 26, 2002

In reply to refer to: R-02-18 and -19

Honorable Jennifer L. Dorn
Administrator
Federal Transit Administration
400 7th Street, S.W.
Room 9328
Washington, D.C. 20590

Within a 2-month period in 2001, the Chicago Transit Authority (CTA) experienced two similar rear-end collisions involving CTA rapid transit trains. Both accidents were preceded by the train operators' having failed to comply with operating rules designed to prevent collisions. The investigation of the two accidents highlighted deficiencies in the CTA management's approach to ensuring rules compliance among its operators.[1]

The first accident occurred about 11:40 a.m., central daylight time, on Sunday, June 17, 2001, when CTA train 104, en route from downtown Chicago to O'Hare Airport, collided with standing CTA train 207. Each train consisted of four passenger cars. About 75 passengers were on train 104, and about 40 passengers were on train 207. Eighteen passengers, an off-duty CTA employee, and both train operators sustained minor injuries. The CTA estimated damages at $30,000.

The National Transportation Safety Board determined that the probable cause of the accident was the failure of the operator of train 104 to comply with operating rules. Contributing to the accident was the failure of CTA's management to exercise adequate operational safety oversight.

The second accident occurred about 9:04 a.m., central daylight time, on Friday, August 3, 2001, when CTA train 416, en route from Kimball to downtown Chicago, collided with standing CTA train 505. Each train consisted of six passenger cars. The accident occurred during morning rush hour, and both trains had standing loads estimated at 90 passengers per car. Chicago Police Department logs indicate that 118 people were transported to area hospitals with minor injuries, none of which were life threatening. The CTA estimated damages at $136,138.

---

[1] For additional information, see forthcoming Railroad Special Investigation Report—*Two Rear-End Collisions Involving Chicago Transit Authority Rapid Transit Trains at Chicago, Illinois, June 17 and August 3, 2001* (NTSB/SIR-02/01).

The Safety Board determined that the probable cause of the accident was the failure of the operator of train 416 to comply with operating rules. Contributing to the accident was the failure of CTA's management to exercise adequate operational safety oversight.

In addition to its own internal safety audit program, the CTA has also engaged the American Public Transportation Association (APTA) to conduct periodic safety audits. The last APTA safety audit before the accident, which was conducted in 1998, took no exception to how transportation line management oversaw operators' rules compliance. APTA's audit did not include a checklist item specifically addressing the training department's program of twice-yearly check rides with operators or the safety department's monitoring of operating rules compliance. The APTA audit process creates a unique checklist for every transit system it audits. The checklist is based on the transit system's system safety program plan.

Item 12 on the APTA System Safety Checklist in the *Manual for the Development of Rail Transit System Safety Program Plans* addresses rules/procedure reviews. The manual indicates that records reviews and supplemental spot checks are the methods to use in determining whether rules are being followed. There is little specific guidance on what rules compliance programs should entail or how they should be efficiently implemented.

The Safety Board concluded that the APTA manual, published on August 20, 1991, does not contain the necessary specific guidance for assessing the effectiveness of rules compliance programs; as a result, the guidelines are not effective tools for regulatory authorities or transit agencies.

The Safety Board, therefore, believes that APTA should modify the manual to provide specific guidance on auditing the effectiveness of operating rules compliance programs by referencing the APTA standard covering transit rules compliance and efficiency test programs as audit criteria.

Because the Federal Transit Administration (FTA) requires that fixed guideway transit systems, such as the CTA's rail transit system, develop and implement a system safety program plan that complies with the guidelines in the 1991 APTA manual, the Safety Board believes that the FTA should adopt the APTA manual that contains updated language on auditing the effectiveness of operating rules compliance programs. Further, the Safety Board believes that the FTA should simultaneously modify 49 *Code of Federal Regulations* Part 659 so that the Part always references the current APTA manual.

The investigation of the second CTA accident showed that some CTA rail transit cars contain a system for preserving a limited amount of train performance data when an accident involves a specific triggering event (in this case, propulsion breakers on two rail cars were knocked out of position by the collision impact). The data loggers record only a limited amount of data and will record over existing data if new triggering events occur. (Event recorders collect a much greater variety of data and record for a much longer period of time.) It was happenstance that the accident involved a triggering event and, thus, that data was available to investigators. Had the triggering event not occurred, as was the case on the remainder of the cars in the train, no train performance data would have been captured. The Safety Board, therefore, concluded that, because the transit cars involved in these accidents either did not have event recorders or had event recorders with only limited data-recording capability, insufficient information was available to provide the basis for a thorough analysis of the actions of the operators and the performance of the trains before the collisions.

APTA is sponsoring a working group, the APTA Rail Transit Standards Development Vehicle Inspection and Maintenance Committee, that is addressing event recorders on rail transit vehicles, as well as a variety of other maintenance issues. The committee consists of representatives from APTA, various transit properties, consultants, and government entities. The committee is addressing inspection and maintenance standards and recommended practices for rail transit event recorders. The committee's recorder standard is expected to detail maintenance intervals and techniques for data, voice, and image recording systems (where available) on transit vehicles. The group defers to the Institute of Electrical and Electronics Engineers (IEEE) Standard (1482.1) for any recommended operational and crashworthiness standards. The committee expects to have a final draft standard for rail transit event recording systems by the end of 2002.

In response to Safety Board recommendations to the transit industry through APTA, the CTA has developed a draft specification and intends to equip its new rail transit cars with event recorders meeting the IEEE 1482.1 standard. While the Safety Board is encouraged by the CTA's plans to equip its future rail rapid transit cars with event recorders, the Board is concerned that other transit agencies may not share the commitment. To help expedite expanded employment of event recorders in rail transit vehicles, the Safety Board believes that the FTA should require that new or rehabilitated vehicles funded by FTA grants be equipped with event recorders meeting IEEE Standard 1482.1 for rail transit vehicle event recorders.

Therefore, the National Transportation Safety Board makes the following safety recommendations to the Federal Transit Administration:

> Adopt the American Public Transportation Association manual that contains updated language on auditing the effectiveness of operating rules compliance programs, and simultaneously modify 49 *Code of Federal Regulations* Part 659 so that the Part always references the current American Public Transportation Association manual. (R-02-18)
>
> Require that new or rehabilitated vehicles funded by Federal Transit Administration grants be equipped with event recorders meeting Institute of Electrical and Electronics Engineers Standard 1482.1 for rail transit vehicle event recorders. (R-02-19)

Also, the Safety Board issued safety recommendations to the American Public Transportation Association and the Chicago Transit Authority. In your response to the recommendations in this letter, please refer to Safety Recommendations R-02-18 and -19. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.[2]

Original Signed

By: Carol J. Carmody
Acting Chairman

[2] At the time the report was adopted (September 4, 2002), Ms. Marion C. Blakey was the Chairman.

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 26, 2002

In reply refer to: R-02-20 and -21

Mr. William Millar
President
American Public Transportation Association
1666 K Street, N.W.
Washington, D.C. 20006

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendations in this letter. The Safety Board is vitally interested in these recommendations because they are designed to prevent accidents and save lives.

These recommendations address the adequacy of the Chicago Transit Authority's (CTA's) programs for ensuring compliance with its operating rules and the adequacy of the CTA's system safety program plan and its internal safety audit program for identifying and resolving systemic safety issues. The recommendations are derived from the Safety Board's investigation of two CTA train collisions at Chicago, Illinois, in 2001 and are consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued five safety recommendations, two of which are addressed to the American Public Transportation Association (APTA). Information supporting the recommendations is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendations.

Within a 2-month period in 2001, the CTA experienced two similar rear-end collisions involving CTA rapid transit trains. Both accidents were preceded by the train operators' having failed to comply with operating rules designed to prevent collisions. The investigation of the two accidents highlighted deficiencies in the CTA management's approach to ensuring rules compliance among its operators.[1]

[1] For additional information, see forthcoming Railroad Special Investigation Report—*Two Rear-End Collisions Involving Chicago Transit Authority Rapid Transit Trains at Chicago, Illinois, June 17 and August 3, 2001* (NTSB/SIR-02/01).

The first accident occurred about 11:40 a.m., central daylight time, on Sunday, June 17, 2001, when CTA train 104, en route from downtown Chicago to O'Hare Airport, collided with standing CTA train 207. Each train consisted of four passenger cars. About 75 passengers were on train 104, and about 40 passengers were on train 207. Eighteen passengers, an off-duty CTA employee, and both train operators sustained minor injuries. The CTA estimated damages at $30,000.

The Safety Board determined that the probable cause of the accident was the failure of the operator of train 104 to comply with operating rules. Contributing to the accident was the failure of CTA's management to exercise adequate operational safety oversight.

The second accident occurred about 9:04 a.m., central daylight time, on Friday, August 3, 2001, when CTA train 416, en route from Kimball to downtown Chicago, collided with standing CTA train 505. Each train consisted of six passenger cars. The accident occurred during morning rush hour, and both trains had standing loads estimated at 90 passengers per car. Chicago Police Department logs indicate that 118 people were transported to area hospitals with minor injuries, none of which were life threatening. The CTA estimated damages at $136,138.

The Safety Board determined that the probable cause of the accident was the failure of the operator of train 416 to comply with operating rules. Contributing to the accident was the failure of CTA's management to exercise adequate operational safety oversight.

In both accidents, operators knowingly violated operating rules. Both accident operators indicated that they had observed similar rule violations by other employees or managers; and, in fact, Safety Board investigators observed a CTA manager violating a CTA operating rule. Limited field interviews with CTA operating personnel indicated such rules violations were more widespread than the occurrence of two accidents might suggest.

The CTA's system safety program plan not inappropriately assigns primary responsibility for operations rules compliance to the operations department. During the course of the investigation, the Safety Board found that the actual implementation of the CTA's rules compliance program did not match the description in the plan. For example, the primary ways management was supposed to monitor operators' rules compliance was by having rail supervisors and line managers do ride checks and point checks. But the twice yearly monitoring of operators by training instructors described in the plan was not being done. Also, the CTA safety department checks were not being made, at least in the cases of the two accident operators.

But even if the point checks and ride checks had been performed in accordance with the established schedule, the Safety Board is not convinced that they would have been effective in ensuring that operators strictly and consistently adhered to operating rules. For example, point checks are performed at a station and, thus, do not permit an evaluation of most operating rules. Ride checks are performed inside the operating cab, and the operator is aware of the evaluator's presence. Operators may be expected to follow the rules to the letter during such evaluations, but management has no assurance that the operator will exercise the same diligence when he or she is not being observed. The Safety Board concluded that the CTA's program for the enforcement of operating rules was inadequate in design and execution and that, consequently, rules violations, such as those related to these two accidents, were not uncommon.

The CTA does not have unannounced efficiency tests or tests for rules compliance in which the operator is not aware that a test is in progress, nor does the Federal Transit Administration require such tests. In contrast, the Federal Railroad Administration (FRA) regulations (49 *Code of Federal Regulations* 217.9) specifically address a program of operational tests, inspections, and record-keeping on railroads subject to FRA jurisdiction. Such rules compliance programs typically include check rides and efficiency tests.[2] Most railroads also periodically review event recorder data to confirm that engineers are following the rules.

In the view of the Safety Board, rules compliance enforcement programs can be as effective in preventing accidents in the transit industry as they are in the railroad industry. The CTA would benefit from a comprehensive program of evaluations and efficiency tests similar to those in the railroad industry and in other transit agencies. The Safety Board, therefore, believes that the CTA should develop and implement systematic procedures for performing and documenting frequent management checks to ensure all operating personnel are complying with CTA operating rules, including speed restrictions and signal rules.

Such a rules compliance program might include procedures for supervisors to follow in making unannounced observations, field audits at stop signals and of speed restrictions, and periodic reviews of event recorder data.

A potential resource for transit agencies in establishing and maintaining a safe transit system is APTA's standards and best practices that are currently in development. The Safety Board believes that APTA should include specific guidance for transit operators on performing unannounced rules compliance observations and efficiency tests as the General Rule Standard for Rule Compliance and Implementation is developed.

In addition to its own internal safety audit program, the CTA has also engaged APTA to conduct periodic safety audits. The last APTA safety audit before the accident, which was conducted in 1998, took no exception to how transportation line management oversaw operators' rules compliance. APTA's audit did not include a checklist item specifically addressing the training department's program of twice-yearly check rides with operators or the safety department's monitoring of operating rules compliance. The APTA audit process creates a unique checklist for every transit system it audits. The checklist is based on the transit system's system safety program plan.

Item 12 on the APTA System Safety Checklist in the *Manual for the Development of Rail Transit System Safety Program Plans* addresses rules/procedure reviews. The manual indicates that records reviews and supplemental spot checks are the methods to use in determining whether rules are being followed. There is little specific guidance on what rules compliance programs should entail or how they should be efficiently implemented.

The Safety Board concluded that the APTA manual, published on August 20, 1991, does not contain the necessary specific guidance for assessing the effectiveness of rules compliance programs; as a result, the guidelines are not effective tools for regulatory authorities or transit agencies.

---

[2] Efficiency tests involve setting up a scenario, such as a stop signal, and documenting the operating crew's actions to verify that applicable rules are complied with.

The Safety Board, therefore, believes that APTA should modify the manual to provide specific guidance for transit agencies to use in auditing the effectiveness of their operating rules compliance programs by referencing the APTA standard covering transit rules compliance and efficiency test programs as audit criteria.

Therefore, the National Transportation Safety Board makes the following safety recommendations to the American Public Transportation Association:

> Include specific guidance for transit operators on performing unannounced rules compliance observations and efficiency tests as the General Rule Standard for Rule Compliance and Implementation is developed. (R-02-20)
>
> Modify the *Manual for the Development of Rail Transit System Safety Program Plans* to provide specific guidance for transit agencies to use in auditing the effectiveness of their operating rules compliance programs by referencing the American Public Transportation Association standard covering transit rules compliance and efficiency test programs as audit criteria. (R-02-21)

The Safety Board also issued safety recommendations to the Federal Transit Administration and the Chicago Transit Authority. In your response to the recommendations in this letter, please refer to Safety Recommendations R-02-20 and -21. If you need additional information, you may call (202) 314-6177.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.[3]

Original Signed

By: Carol J. Carmody
Acting Chairman

---

[3] At the time the report was adopted (September 4, 2002), Ms. Marion C. Blakey was the Chairman.

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 26, 2002

In reply refer to: R-02-22

Mr. Frank Kruesi
President
Chicago Transit Authority
120 North Racine
Chicago, Illinois 60607

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

The recommendation addresses the adequacy of the Chicago Transit Authority's (CTA's) programs for ensuring compliance with its operating rules and the adequacy of the CTA's system safety program plan and its internal safety audit program for identifying and resolving systemic safety issues. The recommendation is derived from the Safety Board's investigation of two CTA train collisions at Chicago, Illinois, in 2001 and is consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued five safety recommendations, one of which is addressed to the CTA. Information supporting the recommendation is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendation.

Within a 2-month period in 2001, the CTA experienced two similar rear-end collisions involving CTA rapid transit trains. Both accidents were preceded by the train operators' having failed to comply with operating rules designed to prevent collisions. The investigation of the two accidents highlighted deficiencies in the CTA management's approach to ensuring rules compliance among its operators.[1]

The first accident occurred about 11:40 a.m., central daylight time, on Sunday, June 17, 2001, when CTA train 104, en route from downtown Chicago to O'Hare Airport, collided with standing CTA train 207. Each train consisted of four passenger cars. About 75 passengers were

[1] For additional information, see forthcoming Railroad Special Investigation Report—*Two Rear-End Collisions Involving Chicago Transit Authority Rapid Transit Trains at Chicago, Illinois, June 17 and August 3, 2001* (NTSB/SIR-02/01).

on train 104, and about 40 passengers were on train 207. Eighteen passengers, an off-duty CTA employee, and both train operators sustained minor injuries. The CTA estimated damages at $30,000.

The Safety Board determined that the probable cause of the accident was the failure of the operator of train 104 to comply with operating rules. Contributing to the accident was the failure of CTA's management to exercise adequate operational safety oversight.

The second accident occurred about 9:04 a.m., central daylight time, on Friday, August 3, 2001, when CTA train 416, en route from Kimball to downtown Chicago, collided with standing CTA train 505. Each train consisted of six passenger cars. The accident occurred during morning rush hour, and both trains had standing loads estimated at 90 passengers per car. Chicago Police Department logs indicate that 118 people were transported to area hospitals with minor injuries, none of which were life threatening. The CTA estimated damages at $136,138.

The Safety Board determined that the probable cause of the accident was the failure of the operator of train 416 to comply with operating rules. Contributing to the accident was the failure of CTA's management to exercise adequate operational safety oversight.

In both accidents, operators knowingly violated operating rules. Both accident operators indicated that they had observed similar rule violations by other employees or managers; and, in fact, Safety Board investigators observed a CTA manager violating a CTA operating rule. Limited field interviews with CTA operating personnel indicated such rules violations were more widespread than the occurrence of two accidents might suggest.

The CTA's system safety program plan not inappropriately assigns primary responsibility for operations rules compliance to the operations department. During the course of the investigation, the Safety Board found that the actual implementation of the CTA's rules compliance program did not match the description in the plan. For example, the primary ways management was supposed to monitor operators' rules compliance was by having rail supervisors and line managers do ride checks and point checks. But the twice yearly monitoring of operators by training instructors described in the plan was not being done. Also, the CTA safety department checks were not being made, at least in the cases of the two accident operators.

But even if the point checks and ride checks had been performed in accordance with the established schedule, the Safety Board is not convinced that they would have been effective in ensuring that operators strictly and consistently adhered to operating rules. For example, point checks are performed at a station and, thus, do not permit an evaluation of most operating rules. Ride checks are performed inside the operating cab, and the operator is aware of the evaluator's presence. Operators may be expected to follow the rules to the letter during such evaluations, but management has no assurance that the operator will exercise the same diligence when he or she is not being observed. The Safety Board concluded that the CTA's program for the enforcement of operating rules was inadequate in design and execution and that, consequently, rules violations, such as those related to these two accidents, were not uncommon.

The CTA does not have unannounced efficiency tests or tests for rules compliance in which the operator is not aware that a test is in progress, nor does the Federal Transit Administration require such tests. In contrast, the Federal Railroad Administration (FRA) regulations (49 *Code of Federal Regulations* 217.9) specifically address a program of operational tests, inspections, and record-keeping on railroads subject to FRA jurisdiction. Such rules compliance programs typically include check rides and efficiency tests.[2] Most railroads also periodically review event recorder data to confirm that engineers are following the rules.

Convening an independent panel of experts from other railroads and transit agencies is one of the methods used in the transit industry when an agency, such as the CTA, needs advice on program improvements or has had a significant series of accidents. Such a "peer review" or "blue ribbon panel"[3] is a cost-effective way to allow an agency to tap industry experts who have experience with the best industry practices in other organizations. The Safety Board hopes that the CTA will obtain the best advice possible in strengthening its operating rules compliance programs.

In the view of the Safety Board, rules compliance enforcement programs can be as effective in preventing accidents in the transit industry as they are in the railroad industry. Consequently, the Safety Board has previously urged transit agencies to strengthen their rules compliance enforcement programs. As shown by the June 17 and August 3 accidents, the CTA would benefit from a comprehensive program of evaluations and efficiency tests similar to those in the railroad industry and in other transit agencies.

Therefore, the National Transportation Safety Board makes the following safety recommendation to the Chicago Transit Authority:

> Develop and implement systematic procedures for performing and documenting frequent management checks to ensure all operating personnel are complying with Chicago Transit Authority operating rules, including speed restrictions and signal rules. (R-02-22)

The Safety Board also issued safety recommendations to the Federal Transit Administration and the American Public Transportation Association. In your response to the recommendation in this letter, please refer to Safety Recommendation R-02-22. If you need additional information, you may call (202) 314-6177.

---

[2] Efficiency tests involve setting up a scenario, such as a stop signal, and documenting the operating crew's actions to verify that applicable rules are complied with.

[3] APTA has a program to organize peer reviews at the request of transit agencies, although some agencies organize such reviews on their own or through consultants.

Chairman BLAKEY, Vice Chairman CARMODY, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.[4]

Original Signed

By: Carol J. Carmody
Acting Chairman

[4] At the time the report was adopted (September 4, 2002), Ms. Marion C. Blakey was the Chairman.